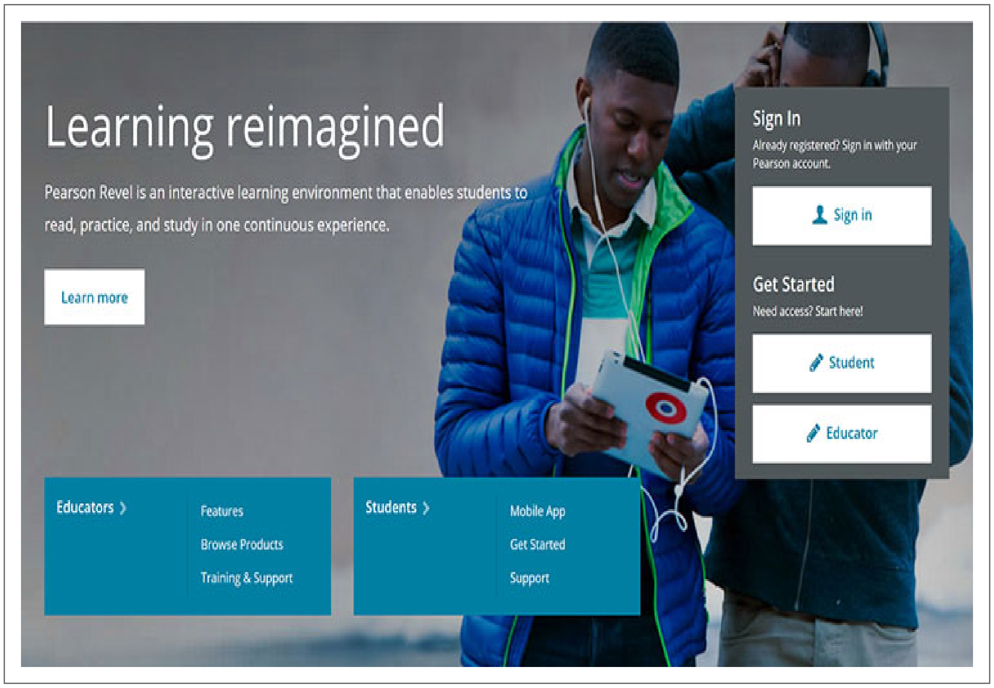
An Introduction to Psychological Science

Third Canadian Edition

Mark Krause
Daniel Corts
Stephen Smith

About Revel and This Course



Pearson Education

About This Course

From the Authors

It is our privilege to welcome you to the third Canadian edition of *An Introduction to Psychological Science*. We would not have had this opportunity without the support and feedback of the instructors who have adopted this book for their classes, and from their students (and our own) who have learned from this book. Why is it time for a third edition? As you should already know, psychological science progresses quickly, and we want to ensure we represent significant advances or theoretical challenges that are happening right now. In addition, there are examples

and applications of psychological principles in the media all of the time, and we want to include these in the learning experience, whether in the text or in online activities. While keeping the book up-to-date with the latest research and current events, we also want to improve on our presentation of classic studies, research methods, and so on that remain in the foundation of our discipline. This is where the feedback from our readers has been so important. Thanks to everyone who has shared what they have enjoyed about this book as well as what we might be able to do better—we believe we have, in fact, done better!

Despite the updates and fine-tuning, the heart of this project has always been *scientific literacy*. The term indicates that memorizing facts should not be the ultimate objective of your introduction to psychology; instead *literacy* emphasizes your ability to encounter, understand, and evaluate scientific information. Scientific literacy comprises four interrelated components:

1. **Knowledge:** What do we know about a phenomenon?

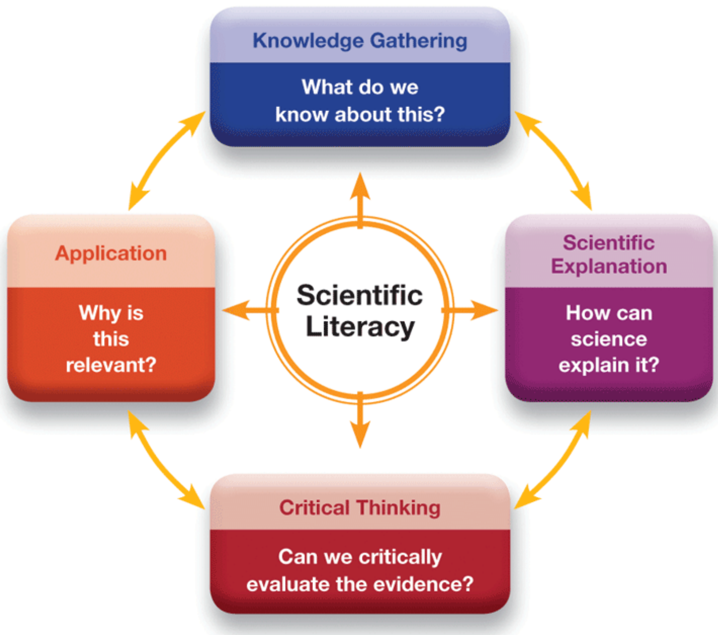
2. **Scientific explanation:** How does science explain the psychological process we are examining?

3. **Critical thinking:** How do we interpret and evaluate all types of information, including scientific reporting?

4. **Application:** How does research apply to our own lives and to society?

To make scientific literacy the core of our book and the Revel experience, we developed content, quizzes, activities, and other features with the scientific literacy model (shown in the graphic) as a guide. This represents how the four competencies each represent a different facet of scientific literacy, whereas the multidirectional arrows show their

interdependence. In other words, you can't use scientific information (Application) if you don't fully understand it (Knowledge), or if there are not sound data and reasoning to support it (Scientific Explanation and Critical Thinking).



An Introduction to Psychological Science presents students with a model for scientific literacy; this model forms the core of how this book is written and organized. We believe a scientific literacy perspective and model will prove useful in addressing two course needs we often hear from instructors—to provide students with a systematic way to categorize the overwhelming amount of information they are confronted with, and to cultivate their curiosity and help them understand the relevance, practicality, and immense appeal of psychological science.

Psychological science is in a privileged position to help students hone their scientific literacy. It is both a rigorous scientific discipline and a field that studies the most complex of all phenomena: the behavioural, cognitive, and biological basis of behaviour. With this focus on

behaviour, one can rightly argue that psychology resides at the hub or core of numerous other scientific disciplines; it also shares connections with neuroscience, education, and public health, to name a few linkages. From this perspective, the knowledge acquired by studying psychological science should transfer and apply to many other fields. This is great news when you consider that psychology is one of the few science courses that many undergraduates will ever take.

In the third Canadian edition of this textbook, we have continued our emphasis on helping the readers organize and assess their thinking and learning about the material. Each module includes learning objectives of increasing depth (knowing, understanding, analyzing, and applying) as well as quiz items that assess learning at each level. We have also included interactive materials using the Revel platform (found in the e-version of this book). Together, these tools should help make the concepts relevant to readers' lives; this, in turn, should improve retention of the course material.

We would like to thank the many instructors and students who have helped us craft this model and apply it to our discipline, and we look forward to your feedback. Please feel free to contact us and share your experiences with the third Canadian edition of *An Introduction to Psychological Science*.

Mark Krause: krausema@sou.edu

Daniel Corts: danielcorts@augustana.edu

Stephen Smith: s.smith@uwinnipeg.ca

Content Highlights

Writing the first Canadian edition of *An Introduction to Psychological Science* gave us a new appreciation for how important Canadian researchers have been to the study of psychological science. Although Canada is a relatively small country (in population and the number of research institutions), Canadian researchers have made incredibly important contributions to a number of areas of psychology. These important contributions are again highlighted in the third Canadian edition. We have also continued to focus on issues that are of particular relevance to Canadians, including bilingualism, environmental psychology, and the experiences of first- and second-generation immigrants to Canada.

As introductory psychology professors ourselves, we had a chance to use the first and second editions of our textbook in our own classes. The third edition of our textbook provides us with an opportunity to (1) add new, cutting-edge material to the discussion of various areas of our field, and (2) expand on topics that our own students have found particularly interesting. In fact, several of the changes to this edition of the book are a result of feedback and discussions with students in Winnipeg (as well as a few *much-appreciated* emails from students at other institutions).

The majority of university students are *digital natives,* meaning they have never lived in a world without mobile phones, the internet, and social media. These technological advances have brought about psychological changes. We study, work, relax, and socialize differently because many of these activities now take place over Instagram, Twitter, and other apps. In order to get readers thinking critically about psychology in our electronic lives, we have added the new #Psych feature. This feature addresses topics such as how to deal with misinformation on the internet, the

impact of screen time on sleep, and how social networks may not be a good substitute for old-fashioned, face-to-face contact. Importantly, this section is not entirely negative! This feature also highlights potential benefits of the wired world, such as providing internet-based therapy for people who live in remote locations.

Each chapter of the third edition of this textbook has been updated to reflect the latest discoveries in psychology. Indeed, we have added new topics to all 16 chapters in the book. Here are some examples:

• Chapter 1, Introducing Psychological Science, describes the foundations of psychology, which are unlikely to change: the nature of science, scientific literacy, and especially critical thinking. However, the world around us is definitely changing. To keep up with the times, Chapter 1 introduces the new feature, #Psych. This feature will appear in each chapter as a way of illustrating how psychology is found in the digital world while focusing on the content from that chapter. The first #Psych shows the importance of our foundational concepts when we encounter information online. How can we tell science from pseudoscience, where do we go to find accurate information, and how can we tell reliable news from propaganda?

• Chapter 2, Reading and Evaluating Scientific Research, features updated examples illustrating topics such as the "replication crisis" and falsifiability.

• Chapter 3, Biological Psychology, includes a more streamlined discussion of evolution and the brain. We have also added new information about neuroplasticity and video games, a topic that will likely interest a number of readers.

- Chapter 4, Sensation and Perception, now includes a #Psych feature focusing on autonomous sensory meridian response (ASMR), a recently identified example of atypical multimodal integration, and up-to-date citations on brain imaging of this phenomenon. We have also included scientific research on how magicians utilize principles of sensation and perception in their craft. A new application activity on noise exposure and hearing loss was added to the module on hearing.

- Chapter 5, Consciousness, includes a #Psych feature about the effects of the blue light from smart phones on our circadian rhythms. We have also performed extensive revisions of the Drugs and Conscious Experience module in order to account for the fact that marijuana is now legal in Canada. These updates include new information about the effects of marijuana on the brain as well as a discussion of how legalization affected drug use in other countries.

- Chapter 6, Learning, includes updated research on the topic of violent video game play and aggression. This is an unresolved question, with much research and meta-analyses showing weak or nonexistent effects of violent game play and actual aggressive behaviour or desensitization to others. We added citations and discussion to reflect the current controversies in this area. We reworked the section on superstitious behaviour as applied to operant conditioning. The major study cited has a published replication failure so we have cited different work that, while less "splashy" in terms of findings, will more faithfully represent research in this area.

- Chapter 7, Memory, includes new information about emotion and memory. We have also revamped our explanations of several concepts and have provided clearer examples of the differences in overlapping concepts (e.g., short-term memory and working memory).

- Chapter 8, Thought and Language, includes increased and refined coverage of culture and cognition along with updates on categorization. The section on humour (introduced in the second edition) was well received, so we included additional content there as well.

- Chapter 9, Intelligence Testing, includes updated and reorganized material on heritability and the concept of *g*. We have shifted away from other topics that have recently received significant criticism from the scientific community and provided a more critical review of the concept of multiple intelligences.

- Chapter 10, Lifespan Development, underwent extensive revision to streamline content and update citations. The #Psych section focuses on the highly relevant topic of digital screen-time exposure for children. Two studies were dropped because of replication failure. The marshmallow test, popular as it is to teach and discuss, has been challenging to replicate and findings may not be nearly as robust as presumed. We will follow the work in this area and integrate it back into the book if additional experiments warrant it. Also, Meltzoff and Moore's classic study of facial imitation in newborns was dropped because of failures to replicate the original work. Despite these changes, we still cover the topics of impulse control, social learning, and imitation from a developmental perspective.

- Chapter 11, Motivation and Emotion, includes major revisions to our discussions of the cognitive factors underlying our motivation to eat. In the Sex module, we have added a discussion of the evolutionary factors influencing our desire to have sex and have also added a new Working the Scientific Literacy Model section that discusses biological explanations of sexual orientation. We have also included a #Psych section about internet pornography and have updated our discussion of the ongoing controversy surrounding Ontario's "sex ed" curriculum.

- Chapter 12, Personality, includes a section featuring industrial and organizational psychology and how personality testing is relevant to employee selection and placement. The #Psych section covers the topic of internet trolling and what personality psychologists can tell us about internet trolls. A new applied activity invites students to examine their own trolling tendencies.

- Chapter 13, Social Psychology, has shifted more toward modern examples and away from classic studies that received some criticism; for example, describing how social pressures may be applied to problem drinking and sexual assaults. We noticed that covering obedience and the bystander effect seemed a little disheartening. To counter that, we added some material emphasizing positive behaviours such as altruism.

- Chapter 14, Health, Stress, and Coping, now features research on relationships between intestinal microbiota and mental health. The #Psych feature tackles the topic of how social media use and exposure relate to mental health. A new application exercise asks students to consider their own attitudes about obesity.

- Chapter 15, Psychological Disorders, underwent the largest revisions in the book. Module 15.1, which focuses on the benefits and challenges of diagnosing psychological disorders, was completely rewritten. It now includes information about why it is important to classify disorders while also noting several factors that make this task quite difficult. We have also added a section about the importance of correctly diagnosing attention-deficit hyperactivity disorder (ADHD). Module 15.2 also underwent very large revisions. We added new sections on Cluster A and Cluster C personality disorders as well as a new Working the Scientific Literacy Module on criminal psychopaths. Several sections of Modules 15.3—which focuses on anxiety, Obsessive-Compulsive, and mood disorders—and Module 15.4—which focuses on schizophrenia—were also updated

and reorganized to improve clarity. Notable among these changes are a clearer explanation of the neuroscience of depression and a #Psych feature on the effect of social media on depression.

• Chapter 16, Therapies, includes new information about the use of MDMA (Ecstasy) for the treatment of posttraumatic stress disorder (PTSD). We have also performed extensive revisions to the sections on barriers that prevent people from seeking help for psychological disorders; these changes include a discussion about how Canada's rural population does not have adequate access to mental health professionals. On a related note, we have also added a #Psych feature discussing the feasibility of internet-based cognitive therapy. We have also updated sections related to the mechanisms of antidepressants and the use of deep brain stimulation for the treatment of psychological disorders.

• Instructors consistently tell us that assessing student progress is a critical component to their course and one of the most time-consuming tasks. Vetted, good-quality, easy-to-use assessment tools are essential. We have been listening and we have responded by creating comprehensive and carefully checked end-of-module and end-of-chapter quizzes as well as homework questions for each chapter in our Revel course. These quizzes contain multiple-choice questions that enable students to assess their comprehension and better prepare for exams. Tied to the learning objectives, these quizzes assess understanding at the four levels of Bloom's taxonomy.

• Upon popular request, we have reinstated the Answer Key at the end of the text. This key provides the answers to the Apply Activity questions presented in the module summaries.

• A new Experiment Simulations appendix in Revel allows students to participate in online simulations of virtual, classic psychology

experiments and research-based inventories, helping to reinforce what they are learning in class and in their book with additional quiz questions.

We believe that these changes (among the many others made to the book) have allowed us to achieve our goal for the third Canadian edition: to provide readers with a thorough description of the field of psychology while also highlighting the importance of scientific literacy and the biopsychosocial model of human behaviour. We hope that you, the reader, feel the same. Enjoy the book!

About the Authors

Dr. Mark Krause received his Bachelor's and Master's degrees at Central Washington University, and his Ph.D. at the University of Tennessee. He completed a postdoctoral appointment at the University of Texas at Austin, where he studied classical conditioning of sexual behaviour in birds. Following this, Krause accepted a research fellowship through the National Institute of Aging to conduct research on cognitive neuroscience at Oregon Health and Sciences University. He has conducted research and published on pointing and communication in chimpanzees, predatory behaviour in snakes, the behavioural and evolutionary basis of conditioned sexual behaviour, and the influence of testosterone on cognition and brain function. Krause is currently a professor of psychology at Southern Oregon University, where his focus is on teaching, writing, and supervising student research. His teaching includes courses in general psychology, comparative psychology, learning and memory, and behavioural neuroscience. His spare time is spent with his family, cycling, reading, and enjoying Oregon's outdoors.

Dr. Daniel Corts discovered psychology at Belmont University, where he received his Bachelor's degree. He completed a Ph.D. in experimental psychology at the University of Tennessee in 1999 and then a postdoctoral position at Furman University for one year where he focused on the teaching of psychology. He is now a professor of psychology at Augustana College in Rock Island, Illinois, where he has taught for over 19 years. His research interests in cognition have led to publications on language and memory, and he has also published in the area of college student development. Corts is also involved in applied work, designing and conducting evaluations for grants funding public education initiatives. Corts is enthusiastic about getting students involved in

research and has supervised or coauthored over 100 conference presentations with undergraduates. Corts is active in Psi Chi, the International Honor Society in Psychology, and recently finished a term as president. In his spare time, he enjoys spending time with his two children, travelling, camping, and cooking.

Dr. Stephen Smith received his Bachelor's degree in psychology and political science from the University of Lethbridge, and his Master's degree and Ph.D. in psychology from the University of Waterloo. After graduating in 2004, he completed a postdoctoral fellowship in the Affective Neuroscience Laboratory at Vanderbilt University in Nashville, Tennessee. Smith is now a professor of psychology at the University of Winnipeg. His research focuses on how emotion, attention, and movement interact, and on how these processes are performed by the nervous system. He has published research on emotional processing in patients with different types of brain damage, the phenomenon of the autonomous sensory meridian response (ASMR), and, using neuroimaging, how emotions influence the activity of cells in both the brain and the spinal cord. Smith's teaching includes introductory psychology, physiological psychology, and third- and fourth-year courses in cognitive neuroscience. In his spare time, he loves to travel, read, play hockey, coach soccer, and spend time with his wife and two young children.

Acknowledgments

We cannot fathom completing a project like this without the help and support of many individuals. Through every bit of this process have been our families and we thank you for your love, patience, and support. In addition, our departments have been wonderfully understanding and helpful, offering advice with their various specializations, providing

examples and tips, reviewing drafts, and tolerating our occasional absences (and grumpy moods).

The third edition of this book was definitely a team effort. Our Content Developer, Dea Barbieri, showed superhuman patience (and an exceptional knowledge of hockey). Ruth Chernia provided amazing copy editing and helped turn our mad scribblings into a coherent book. We are also indebted to Kim Veevers (Executive Portfolio Manager) and to everyone on the production and permissions side of things: Söğüt Güleç, Andrea Falkenberg, Jaime Smith, and Meaghan Lloyd at Pearson Canada, Jennifer Stevenson at Ohlinger Studios, Pradeep Subramani and Shubham Verma at Integra Software Services Pvt. Ltd. We would also like to thank the entire Pearson sales team for promoting this book as well as the supplements team for preparing other online materials.

The third Canadian edition of this book benefited from conversations with a number of colleagues. Doug Williams, Amy Desroches, and Justin Friesen from the University of Winnipeg provided us with interesting insights into different aspects of psychology that ended up influencing several chapters. Mike Dixon from the University of Waterloo (and Steve's former basketball teammate) provided useful information about gambling (Module 6.2). Steve's clinical psychology graduate student, Tracie Parkinson (University of Manitoba), provided a great deal of information that found its way into Chapters 15 (Psychological Disorders) and 16 (Therapies). Finally, we would like to thank the many reviewers and students who carefully read over the first two Canadian editions of this book. We are very grateful that you shared your expertise in the field of psychology, and in teaching, to help bring this book to life.

We value feedback from both instructors and students, and we are sure that we will need it for our fourth Canadian edition. Please do not hesitate to offer suggestions or comments by writing to Mark Krause

(krausema@sou.edu), Dan Corts (danielcorts@augustana.edu), or Steve Smith (s.smith@uwinnipeg.ca).

Dedications

For Andrea, Finn, and Skyler. You fuel my passion and motivation for this endeavor. I cannot thank you enough. —Mark Krause

To Kim, Sophie, and Jonah, for your patience, understanding, and forgiveness during all the hours this project has occupied me. —Daniel Corts

To my brilliant wife, Jenn, and our hilarious children, Oliver and Clara. Thank you for putting up with me. —Stephen Smith

The Story of Revel—Why Revel?

WATCH Why Revel?

Listen to the Audio

Revel is an interactive learning environment designed for the way today's students read, think, and learn. Revel uses interactives and assessments integrated within the narrative that enhance content as well as students' overall learning experiences.

The story of Revel is simple: When students are engaged in the course content, they learn more effectively and perform better.

When creating your course, you have many choices as to how to supplement your lectures and curriculum. So ask yourself these questions: How do I know if my students are reading their assigned

materials? Do I want my students to have a better understanding of the concepts presented in this class through course materials and lectures? Do I want to see my students perform better throughout the course? If you answered “yes” to these questions, choose Revel.

Monkey Business Images/Shutterstock

Narrative Tells the Story

Listen to the Audio

With Revel, students are introduced to a new learning experience, one in which the most up-to-date content, reading, and interactive learning become one.

We′ve talked to hundreds of instructors about their biggest challenges in teaching their courses. We′ve heard some consistent answers: students are not engaged; students come to class unprepared; students are unable to think critically. However, the most common answer is that students do not read, which leads directly to, and in fact magnifies, the other challenges that instructors identified—lack of student engagement, lack of student preparedness, and an inability to think critically. Our goal in developing Revel was to research why students aren′t reading and to solve that problem first and foremost as a gateway to deeper learning.

wavebreakmedia/Shutterstock

Research and Data

Listen to the Audio

Research shows that for students, reducing the extraneous cognitive load – that is, the mental effort being used in the working memory – is key to learning and retention. When students read or study in order to process and retain information, the information must move from the working memory to the long-term memory. Put simply, reducing extraneous cognitive load increases long-term memory.

Our research also tells us that students do not see the benefits of reading their textbooks. Students perceive their instructor's dynamic lectures and class notes as their main source for learning and view their assigned text as simply a repetition of that classroom experience. In a student's mind, why would they read? What are the benefits?

We share the same goals: to give your students the motivation to read by adding value to their interaction with the course materials, and to make it easier for you to assign reading.

If that's important to you, choose Revel.

The Story of Revel—The Solution

WATCH The Revel Solution

Listen to the Audio

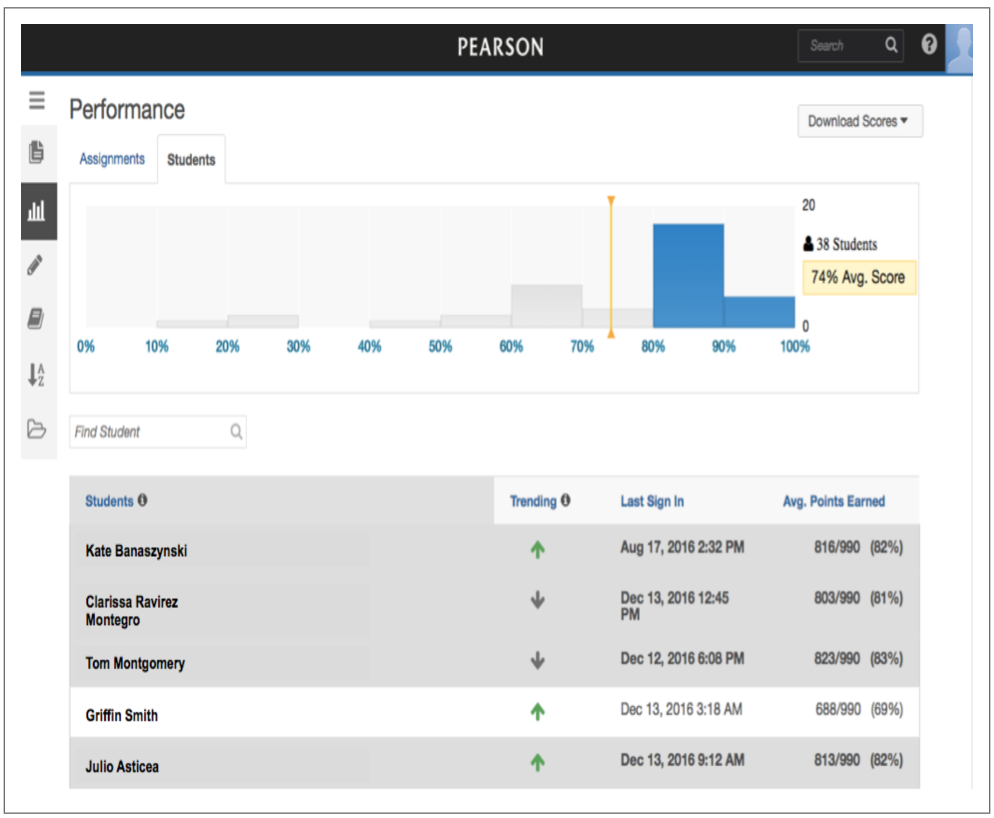
Revel is learning reimagined.

Revel benefits your students. Revel's dynamic content matches the way students learn today. Narrative is supported and enhanced by interactive content and as a result, reading becomes a pleasure rather than a chore. Revel also enables students to read and interact with course material on the devices they use, anywhere and any time. Responsive design allows students to access Revel on their tablets, desktop computers, or mobile devices with content displayed clearly in both portrait and landscape view.

Revel benefits you. Revel allows you to check your students' progress and understanding of core concepts through regular and consistent assessment. End-of-module and end-of-chapter quizzes in Revel allow students opportunities to check their understanding at regular intervals before moving on; their grades are reported to the instructor dashboard.

Revel also offers no-, low-, and high-stakes writing activities for students through the journal, shared writing, and essay activities.

Revel lets you monitor class assignment completion as well as individual student achievement. Do you want to see points earned on quizzes, time on task, and whether a particular student's grade is improving? If so, choose Revel.



Pearson Education

Reading

Listen to the Audio

Our extensive research with both students and instructors found that students who spend time completing their Revel reading assignments come to class better prepared to ask questions and participate in discussions. Revel's assignability and tracking tools help educators make sure students are completing their reading and understanding core concepts. Instructors using Revel can see how frequently students access their reading assignments and how well they understand what they read before they come to class.

Assessments allow instructors to gauge student comprehension frequently, provide timely feedback, and address learning gaps along the way. Stakes associated with assessment instruments can positively impact motivation, which can improve student participation and performance.

oneinchpunch/Fotolia

Learning Design Theory

Listen to the Audio

Over the course of several years, we have worked with thousands of educators, students, and instructional design experts to develop Revel with our authors. All of Revel's key aspects—from features to content to performance dashboard reporting—were guided by interactions with our customers. Each Revel prototype has been tested with educators and students to make sure it facilitates the achievement of their course and individual goals. The result is a new approach to digital learning that gives educators and students precisely what they need to enhance learning and engagement.

INTERACTIVES AND VIDEOS Integrated interactive elements and brief videos allow students to engage with content and take an active role in learning. Revel's interactive learning tools have been designed to be completed quickly so students stay focused and on task.

INTERACTIVITY SPACED ACROSS CONTENT Instructional design research shows that active pauses—with interactive content interspersed within the text narrative—improves learning. Interactive content can often more clearly provide information that is difficult to convey in static text. Revel integrates active pauses to let learners stop and process information using encoding and retrieval processes in the brain (Cheon, Crooks, Chung, Song & Kim, 2014).

FAMILIAR LEARNING AND STUDY TOOLS Highlighting, note taking, and a glossary personalize the learning experience. Instructors can add notes for students, too, including reminders or study tips.

Data and Product Development

Listen to the Audio

Instructional design research shows that taking a test on presented material promotes subsequent learning and retention of that material on a final test. When assessments are implemented appropriately and with specific, timely feedback, students are engaged in the retrieval process, and this act of retrieving solidifies the original learning. (McDaniel, Anderson, Derbish, & Morrisette, 2007; Wiliam 2007).

The Story of Revel—Your Students

WATCH Revel and Your Students

Listen to the Audio

Today's students are busy. Many are not only taking a full class load, but are also working full-time, holding internships, raising families, and commuting to and from campus. As an instructor, you are competing for the limited time that students have outside of class. In addition, you are competing with other courses in which students juggle heavy workloads.

With Revel, students can be efficient with their time. Revel ensures that your course will become a priority, and it will motivate students to complete their reading prior to coming to class. You work hard to give your students a 21st century experience in class, one that incorporates multimedia and technology. With Revel, your students can have that

same experience out of class on their own so that they can be better prepared, and ultimately, more successful, in your class.

Rawpixel.com/Shutterstock

What Students Need

Listen to the Audio

Students need to be motivated to read. Students also need the work they do outside of class to be a valuable use of their limited time. They need to believe that they are spending their time wisely. The interactive elements of Revel ensure that students are getting more than just a digital textbook experience; with Revel, they are “experiencing” the content in new and dynamic ways. Coupled with periodic assessment tools – as well as opportunities to write about what they have read and learned – Revel enhances student learning and retention.

Jacob Lund/Fotolia

Mobile App

Listen to the Audio

The new Revel mobile app lets students read, practice, and study—anywhere, anytime, on any device. Content is available both online and offline, and the app automatically syncs work across all registered devices, giving students greater flexibility to toggle between their phone, tablet, and laptop as they move through their day. The app also lets students customize assignment notifications to stay on top of all due dates.

In spring 2016 and 2017, over 1,600 students at nearly 80 two and four-year colleges and universities responded to a demonstration of Revel. Here is a sample of some student responses:

"Easy to access, no waiting for the textbook to arrive. I can review for tests and it will remind me of upcoming assignments." - Danielle, Normandale Community College

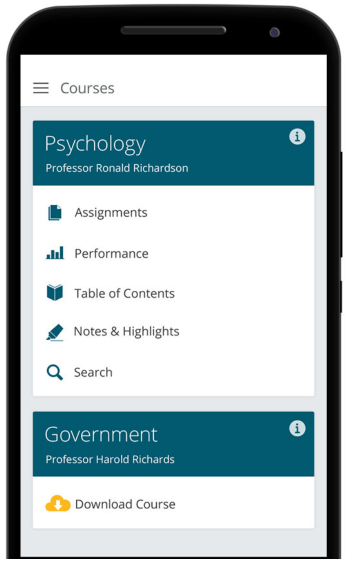
"Simple interface, easy to navigate and very convenient." - Degerio, Guilford Technical Community College

"The future of learning." - Enrique, Des Moines Area Community College

Available for download from the Apple iTunes App Store or Google Play.

OFFLINE ACCESS

Download course material to read, practice and study even when you're offline



Pearson Education

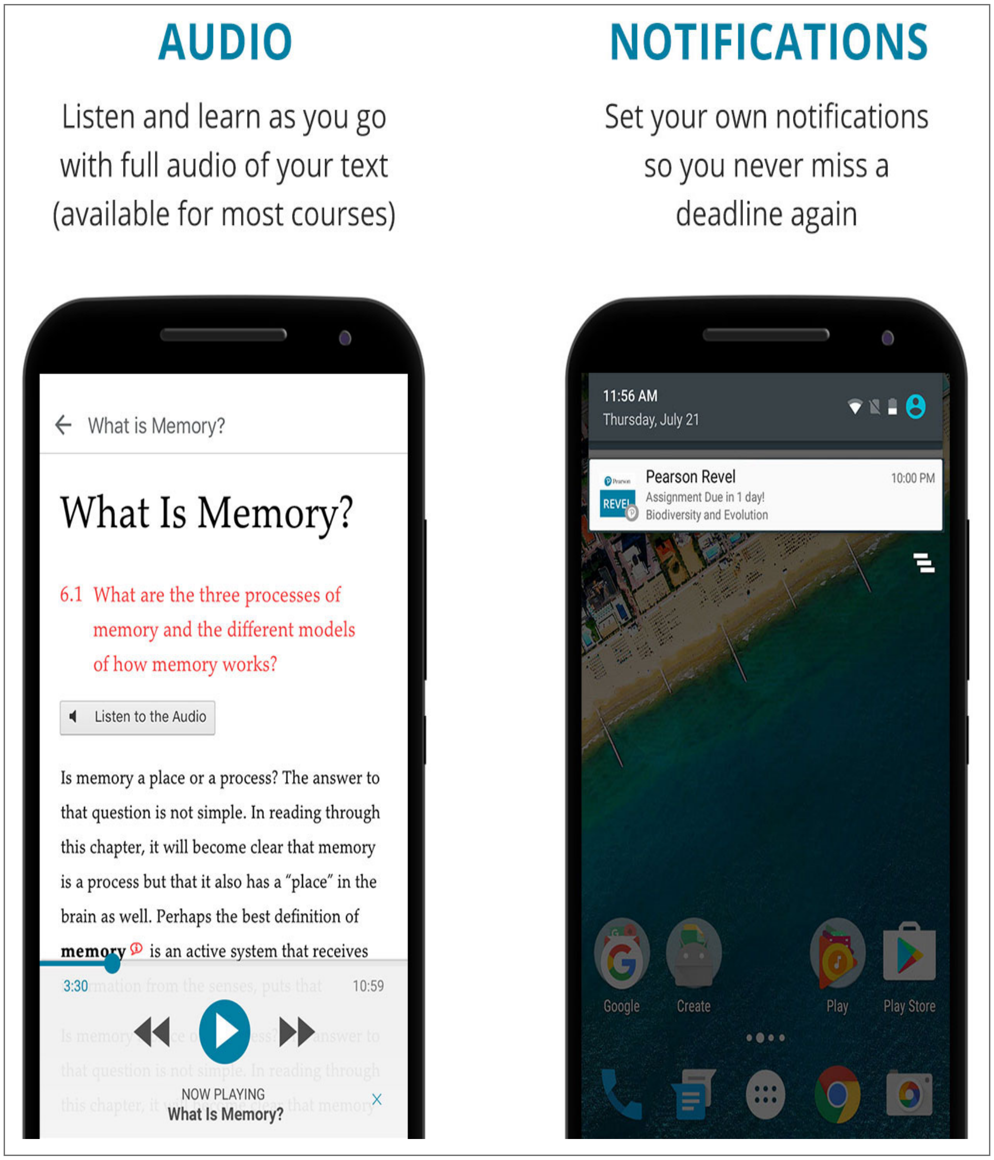
Accessibility

Listen to the Audio

Learning doesn't stop when students walk out of class or step off campus; we designed the mobile app because learning happens where life happens — everywhere.

The Revel app lets students customize assignment notifications to stay on top of all due dates. With the Revel app, students can:

- access the assignment calendar;
- complete reading and quizzes;
- set customized due date reminders;
- check overall performance on their mobile device.



Pearson Education

Support and Implementation—Getting Started with Revel

Listen to the Audio

More than 5,000 Revel instructors are connecting and sharing ideas. They're energizing their classrooms and brainstorming teaching challenges via Pearson's growing network of faculty communities. The Revel community is an open, online space where members come together to collaborate and learn from each other. If you're currently teaching with Revel or considering Revel for use in your class, we invite you to join the Revel community.

Getting started with Revel is easy:

- **Identify the Problems You Want to Solve**
  Do you want students to come to class more prepared, having read their assigned reading? Are your goals focused on improving student success in your course? Are you looking to increase student engagement? Are you interested in flipping your classroom so that students learn basic course content outside of class, allowing for more active and applied in-class learning?
- **Keep It Simple**
  The process of accessing and navigating these learning solutions needs to be simple and intuitive. Revel has built-in, frequent, low-stakes assessments for students to easily assess their understanding of the material, without getting sidetracked from their required reading assignment.

- **Track Learning Gains**

  Educators who track and measure learning gains are able to make informed decisions about product implementations, course transformations, and redesigns. In addition, they can increase their ability to prove institutional effectiveness, meet accreditation standards, track quality-enhancement plans, and fulfill grant requirements.

Rawpixel.com/Shutterstock

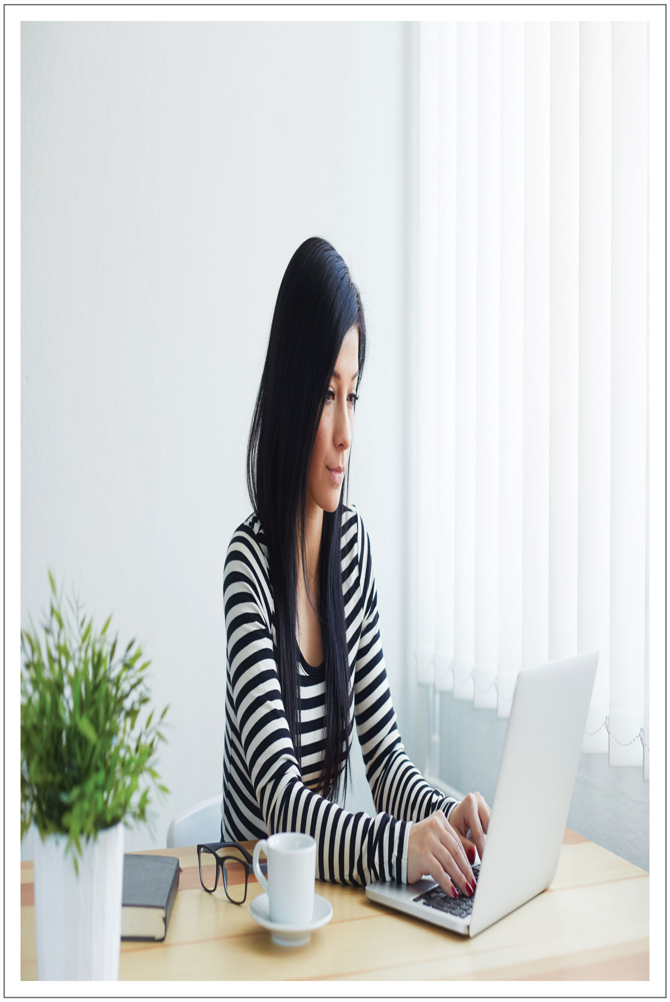
Course Creation, Set-Up, and Assignments

Listen to the Audio

If you have used a Pearson digital product in the past like a MyLab, you can use your same Pearson account info to sign in to Revel.

If you do not have a Pearson account already, click **Educator** in the **Get Started** box, and click **I would like to request access**.

After sign in, you will arrive at Revel's course homepage. Select **Search for Materials** in the upper right-hand corner and enter the title, author, ISBN or keyword of the text you'll be using. When you find your text, click **Create Course**. Fill in your course information, and click **Save**.



Rostislav Sedlacek/Fotolia

The first time you log in to Revel as an instructor you will be prompted to “start creating assignments.” Click **Get Started**.

You are now ready to:

- select content to choose textbook content, interactive media, and graded assignments;
- set due dates to make sure students know what Revel reading and assessments are due and when;
- publish assignments to push content and assignments to students.

BUILDING AN ASSESSMENT PLAN Revel includes various quiz types to use for both formative and summative assessments. To get started, simply assign each Revel module that you intend to cover in your course. Be sure to consider your assignment due dates. If your goal is for students to come to class more prepared, then be sure to make assignments due before those topics are covered in class.

Additionally, think about how you will measure success in this Revel course. What are the quantifiable goals you want to achieve? Pertinent metrics might include one or both of the following:

- an analysis of student engagement using Revel's built-in reporting features or
- a comparison of in-class exam scores, final course grades, or retention rates with those of previous semesters.

Hero Images Inc./Alamy Stock Photo

Dashboard and Analytics

Listen to the Audio

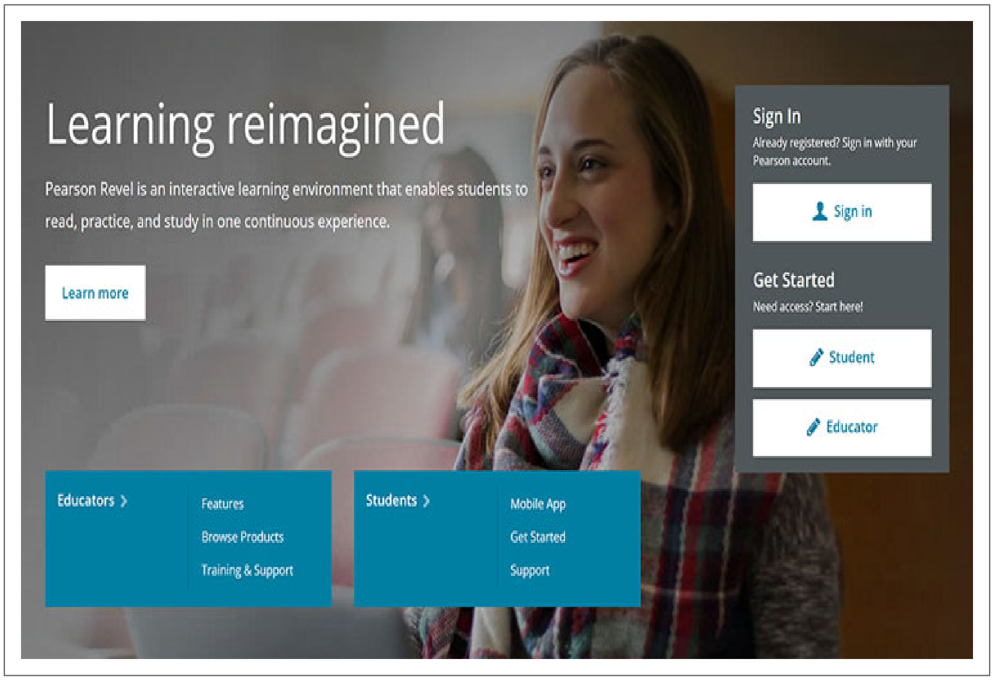
Because students tend to skip optional assignments, it is critical that Revel contributes to the overall course grade. The recommendation of experienced educators is that Revel should represent at least 10-20% of the total course grade.

Remember that when you assign a chapter or section in Revel, you are assigning reading, interactives, videos, and assessments. All you need to do is pick the chapters and topics you want to cover, and then assign them to your students on the Revel assignment calendar. The Performance Dashboard allows you to export the student grades and provides total points earned for easy manual adjustments to external gradebooks.

Instructional design research suggests that certain habits of mind and dispositions are associated with critical thinking skills. Writing can be used as a tool to foster critical thinking. To get students to move toward adopting these habits and dispositions, instruction and assessment should be appropriately complex, and focused on supporting, eliciting, and assessing skills such as evaluation, analysis, synthesis, collaboration, and critical reflection. (Cope, Kalantzis, McCarthey, Vojak & Kline, 2011; Liu, Frankel, & Roohr, 2014).

As a reminder, all Revel product information can be found on the Pearson Revel site.

www.pearson.com/revel



Pearson Education

LMS Integration

Listen to the Audio

Pearson provides Blackboard Learn™, Canvas™, Brightspace by D2L, and Moodle integration, giving institutions, instructors, and students easy access to Revel. Our Revel integration delivers streamlined access to everything your students need for the course in these learning management system (LMS) environments.

SINGLE SIGN-ON With a single sign-on, students are ready on their first day. From your LMS course, students have easy access to an interactive blend of author's narrative, media, and assessment.

wavebreakmedia/Shutterstock

GRADE SYNC Flexible, on-demand grade synchronization capabilities allow you to control exactly which Revel grades should be transferred to the LMS gradebook.

BEFORE YOU GET STARTED

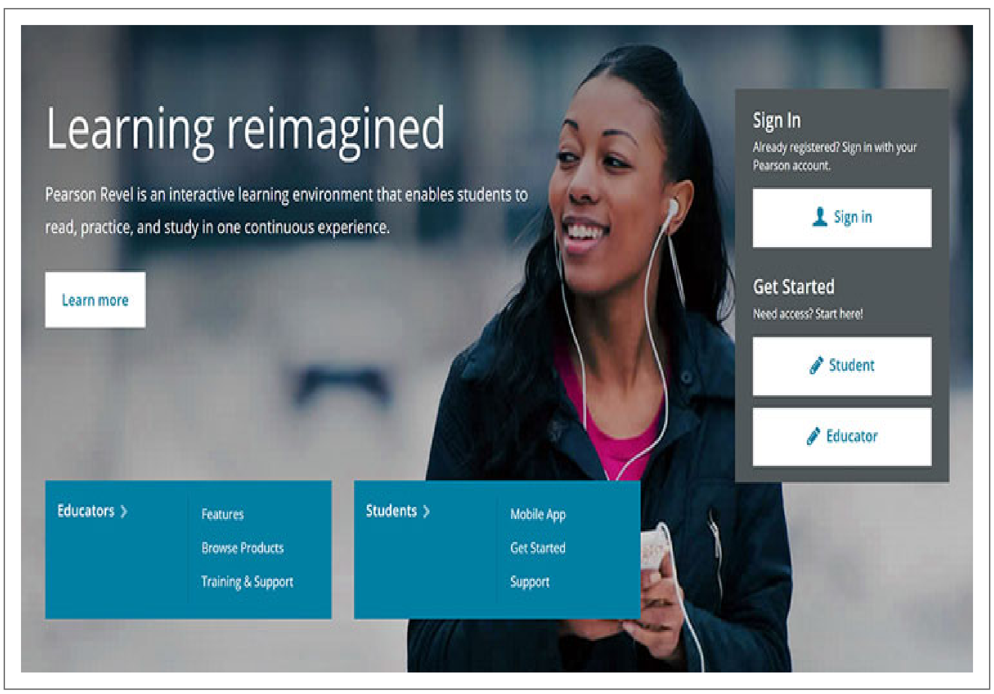
Visit www.pearsonhighered.com/revel/educators/lms-integration-services/ for administration and training guides related to your LMS.

Summary

Listen to the Audio

With Revel, Pearson authors have been able to reimagine the way students learn content, applying new and engaging learning and assessment strategies that were not possible in the past with a print textbook. If you want your students to read, retain what they have read, understand concepts more fully, and develop and apply critical thinking skills, you have one choice.

Choose Revel.



Pearson Education

REFERENCES

Cheon, J., Chung, S., Crooks, S. M., Song, J., & Kim, J. (2014). An investigation of the effects of different types of activities during pauses in a segmented instructional animation. *Journal of Educational Technology & Society, 17(2)*, 296–306.

Cope, B., Kalantzis, M., McCarthey, S., Vojak, C., & Kline, S. (2011). Technology-mediated writing assessments: Principles and processes. *Computers and Composition, 28(2)*, 79–96. DOI: 10.1016/j.compcom.2011.04.007

Liu, O. L., Frankel, L., & Roohr, K. C. (2014). Assessing critical thinking in higher education: Current state and directions for next-generation assessment. ETS Research Reports Series, 2014: 1–23. DOI: 10.1002/ets2.12009

McDaniel, M. A., Anderson, J, L., Derbish, M. H., & Morrisette, N. (2007). Testing the testing effect in the classroom. *European Journal of Cognitive Psychology*, *19:4*, 494–513.

Wiliam, D. (2007). Keeping learning on track: classroom assessment and the regulation of learning. In F. K. Lester Jr (Ed.), *Second handbook of mathematics teaching and learning* (pp. 1053-1098). Greenwich, CT: Information Age Publishing.

Chapter 1
Introducing Psychological Science

Listen to the Audio

1.1 The Science of Psychology

- The Scientific Method
- Building Scientific Literacy
- Working the Scientific Literacy Model: Planning When to Study
- Module 1.1 Summary

1.2 How Psychology Became a Science

- Psychology's Philosophical and Scientific Origins
- The Beginnings of Contemporary Psychology
- Emerging Themes in Psychology
- Module 1.2 Summary

Module 1.1 The Science of Psychology

Listen to the Audio

Everett Collection

Learning Objectives

1.1a Know . . . the key terminology of the scientific method.

1.1b Understand . . . the steps of the scientific method.

1.1c Understand . . . the concept of scientific literacy.

1.1d Apply . . . the biopsychosocial model to behaviour.

1.1e Apply . . . the steps in critical thinking.

1.1f Analyze . . . the use of the term *scientific theory*.

Almost everyone has misinterpreted someone else's meaning in a conversation. You could misinterpret someone leaning closer to you as flirting when really you were just talking too softly. You could mistake someone's tone of voice as being annoyed when that person was actually talking loudly to be heard over other people in the room. We also frequently misjudge other people's attitudes and personalities. The unfriendly and arrogant person at work might actually turn out to be a shy person who dislikes crowded social events. In all of these situations, we make inferences about another person based on the different cues they provide us. But how do we decide which cues are important? Are they really the right cues to be using when we want to explain other people's behaviour?

The situation is even more complicated in the wired world of the 21st century, with everyone plugged in to email, online gaming, and social networking sites like Facebook and Twitter. How do you interpret someone's behaviour or intentions when all you have to go by is words on a screen and cartoon-like happy faces? How much information do you need to (safely) disclose in order for other people to understand you? These questions highlight the complexity of human behaviour as well as some of the challenges involved in trying to understand it. In this text, we will examine many different aspects of behaviour—from basic brain and perception functions to memory to social behaviours.

> *But all of these chapters have the same central theme: the scientific quest to understand why and how we behave the way we do.*

One of the reasons psychology is such an exciting class is that it is easy to see how this field of study relates to your own life. Although chemistry and physics both have a profound effect on our lives, it is sometimes difficult to link formulas and diagrams with real-life experiences. Psychology is visceral—we *feel* emotions, we *take in* sensations, and we *produce* behaviours such as thoughts and actions. Psychology is you.

A more official definition of **psychology** *is the scientific study of behaviour, thought, and experience, and how they can be affected by physical, mental, social, and environmental factors*. This definition shows you that psychology involves a number of overlapping areas of investigation. Some of the overarching goals of psychology include:

- to understand how different brain structures work together to produce our behaviour
- to understand how nature (genetics) and nurture (our upbringing and environment) interact to make us who we are
- to understand how previous experiences influence how we think and act
- to understand how groups—family, culture, and crowds—affect the individual
- to understand how feelings of control can influence happiness and health
- to understand how each of these factors can influence our well-being and could contribute to psychological disorders

Critically, these points are not independent of one another. As we will discuss later in this module, every topic in psychology is examined from multiple perspectives, such as biological, sociocultural, or cognitive

(thinking). As you progress through this text, you will begin to understand the different factors that influence *your* thoughts, actions, and feelings. Psychology can help you see the world in a different way. And, just as important, psychology can help you understand why *other* people behave the way they do. All of the factors that influence you also influence other people in one way or another. By understanding these influences, you can gain a better understanding—and acceptance—of the people around you.

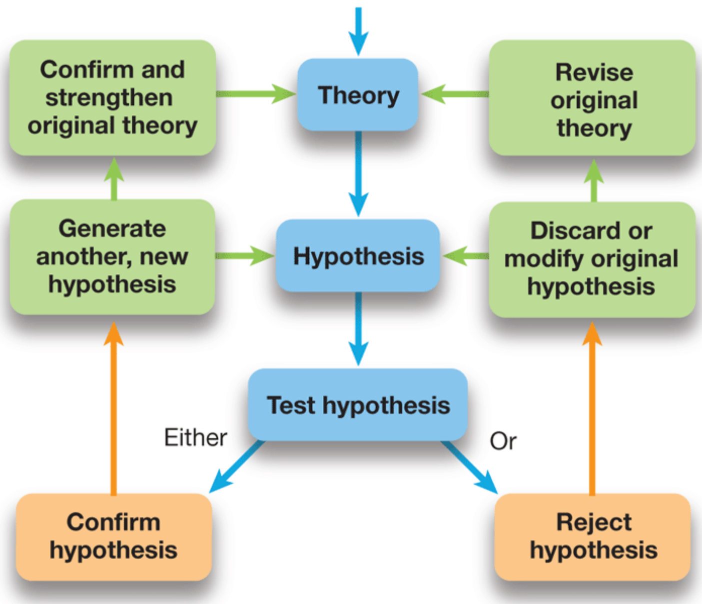
Importantly, our knowledge of human behaviour is not just a series of opinions. Every topic that we will discuss is based on the hard work of scientists who meticulously tested their ideas in laboratories and in the "real world." This text includes many references to their findings as reported in scientific journals (e.g., Eastwood et al., 2016) so you may go straight to the source of the information any time you want to find out more. The science of psychology would be nothing without the scientific method.

The Scientific Method

Listen to the Audio

What exactly does it mean to be a scientist? A person who haphazardly combines chemicals in test tubes may look like a chemist, but he is not conducting science; a person who dissects a specimen just to see how it looks may appear to be a biologist, but this is not science either. In contrast, a person who carefully follows a system of observing, predicting, and testing *is* conducting science, whether the subject matter is chemicals, physiology, human memory, or social interactions. In other words, whether a field of study is a science, or a specific type of research is *scientific*, is based not on the subject but on the use of the scientific method. The **scientific method** *is a way of learning about the world through collecting observations, developing theories to explain them, and using the theories to make predictions*. It involves a dynamic interaction between hypothesis testing and the construction of theories, outlined in Figure 1.1.

Figure 1.1 The Scientific Method



Scientists use theories to generate hypotheses. Once tested, hypotheses are either confirmed or rejected. Confirmed hypotheses lead to new ones and strengthen theories. Rejected hypotheses are revised and tested again, and can potentially alter an existing theory.

Hypotheses: Making Predictions

Listen to the Audio

Scientific thinking and procedures revolve around the concepts of a hypothesis and a theory. Both guide the process and progress of the sciences; however, it is important to differentiate between these terms. A **hypothesis** (plural: hypotheses) *is a testable prediction about processes that can be observed and measured*. A hypothesis can be supported or rejected—you cannot *prove* a hypothesis because it is always possible that a future experiment could show that it is wrong or limited in some way. This support or rejection occurs after scientists have tested the hypothesis. For a hypothesis to be testable, it must be **falsifiable**, meaning that *the hypothesis is precise enough that it could be proven false*. This precision is also important because it will help future researchers if they try to replicate the study (i.e., reproduce the findings) to determine if it the results were due to chance (see Module 2.1 for a more in-depth discussion of replication).

“All swans are white” is a falsifiable statement. A swan that is not coloured white will falsify it. Falsification is a critical component of scientific hypotheses and theories.

Ellie Rothnie/Alamy Stock Photo

These requirements are regularly broken by people claiming to be scientific. For example, astrologers and psychics are in the business of making predictions. An astrologer might tell you, “It’s a good time for you to keep quiet or defer important calls or emails.” This type of statement is impossible to test. If you keep quiet and nothing happens to you, is that due to you following the horoscope or to the fact that you hid from the world? Horoscopes make *very* general predictions—typically so much so that you could easily find evidence for them if you looked hard enough, and perhaps stretched an interpretation of events a bit. In contrast, a good scientific hypothesis is stated in more precise terms that promote testability, such as the following:

> People become less likely to help a stranger if there are others around.

Alcohol reduces the quality of sleep.

Exercise improves memory.

Each of these hypotheses can be confirmed or rejected through scientific testing. An obvious difference between science and astrology is that scientists are eager to test hypotheses such as these, whereas astrologers would rather you just take their word for it. We acknowledge that astrology is an easy target for criticism. In fact, it is often referred to as **pseudoscience**, *an idea that is presented as science but does not actually utilize basic principles of scientific thinking or procedure*. Incidentally, a 2015 poll found that 35% of Canadians believe that the position of the stars in the sky can affect a person's behaviour (Angus Reid Institute, 2015).

Theories: Explaining Phenomena

Listen to the Audio

In contrast to hypotheses, a **theory** *is an explanation for a broad range of observations that also generates new hypotheses and integrates numerous findings into a coherent whole*. In other words, theories are general principles or explanations of some aspect of the world (including human behaviours), whereas hypotheses are specific predictions that can test the theory or, more realistically, specific parts of that theory. Theories are built from hypotheses that are repeatedly tested and confirmed. Similar to hypotheses, an essential quality of scientific theories is that they can be supported *or* proved false with new evidence. If a hypothesis is supported, it provides more support for the theory. In turn, good theories eventually become accepted explanations of behaviour or other phenomena (i.e., they can be used to generate *new* hypotheses). However, if the hypothesis is not supported by the results of a well-designed experiment, then researchers may have to rethink elements of the theory. Figure 1.1 shows how hypothesis testing eventually leads back to the theory from which it was based, and how theories can be updated with new evidence. This process helps to ensure that science is *self-correcting*—bad ideas typically do not last long in the sciences.

The term *theory* is often used very casually, which has led to some persistent and erroneous beliefs about scientific theories. The following points clarify some common misperceptions.

- **Theories are not the same as opinions or beliefs.** Yes, it is certainly true that everyone is entitled to their own beliefs. But the phrase "That's just *your* theory" is confusing the terms *opinion* and *theory*. A theory can help scientists develop testable hypotheses; opinions do not need to be testable, or even logical.
- **All theories are not equally plausible.** Groups of scientists might adopt different theories for explaining the same phenomenon. For example, several theories have been proposed to explain why people become depressed. This does not mean that anyone can throw their hat into the ring and claim equal status for his or her theory (or belief). A good theory can explain previous research and can lead to even more testable hypotheses.
- **The quality of a theory is not related to the number of people who believe it to be true.** The National Center for Science Education reports that, according to a 2018 poll, only 68% of Canadians believe in the theory of evolution by natural selection (Branch, 2018), despite the fact that it is the most plausible, rigorously tested theory of biological change and diversity.

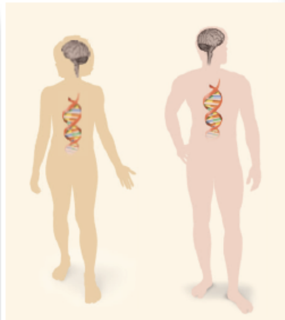
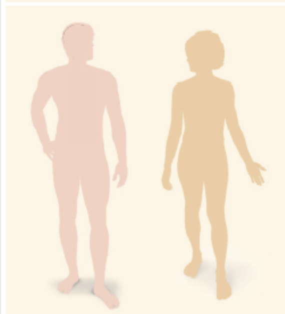
Testing hypotheses and constructing theories are both part of all sciences. Importantly, each science, including psychology, has its own unique way of approaching its complex subject matter as well as its own unique set of challenges. In the case of psychology, we must remember that behaviour can occur on a number of different levels, including the activity of cells in different parts of the brain, thought processes such as language and memory, and sociocultural processes that shape daily life for millions of people. Therefore, psychology examines the individual as a product of multiple influences, including biological, psychological, and social factors.

The Biopsychosocial Model

Listen to the Audio

Because our thoughts and behaviours have multiple influences, psychologists adopt multiple perspectives to understand them. The **biopsychosocial model** *is a means of explaining behaviour as a product of biological, psychological, and sociocultural factors* (see Figure 1.2). Biological influences on our behaviour involve brain structures and chemicals, hormones, and external substances such as drugs. Psychological influences involve our memories, emotions, and personalities, and how these factors shape the way we think about and respond to different people and situations. Finally, social factors such as our family, peers, ethnicity, and culture can have a huge effect on our behaviour. One of the most challenging aspects of psychology is that all of these factors affect your behaviour simultaneously, and can even affect each other. Take an everyday activity like having a meal: your hormones signal that your body needs energy, thinking about the pizza shop down the street can make your mouth water, and a friend may text you asking you to join them for a bite. These are only a fraction of the biopsychosocial causes of eating. Teasing apart the multiple influences of behaviour makes psychology a complex, yet fascinating, discipline.

Figure 1.2 The Biopsychosocial Model

	PERSPECTIVE	FOCUS	EXAMPLES
	Biological	Genes, brain anatomy and function, and evolution	Genetics of behaviour and psychological disorders Brain-behaviour relationships Drug effects
	Psychological	Behaviour, perception, thought, and experience	Language Memory Decision making Personality
	Sociocultural	Interpersonal relationships, families, groups, societies, and ethnicities	Attraction Attitudes and stereotypes Conformity

Psychologists view behaviour from multiple perspectives. A full understanding of human behaviour comes from analyzing biological, psychological, and sociocultural factors.

Review The Biopsychosocial Model

Sawyer's Grade 1 teacher has set up a parent-teacher meeting and invited the school psychologist. They are trying to create a plan to help Sawyer improve his behaviour so he can spend more time in class and less time in the classroom for children with behaviour problems. The biopsychosocial model is their reminder to approach the problem from multiple perspectives. To make sure you can use the model, read each of the following examples and "Check My Understanding" when you're ready.

Perspective	Focus	Examples at School
Biological	Genes & physiology	His father claims to have been on medication for hyperactivity as a student, and suggests that Sawyer may benefit from it because "it's in his genes."
Psychological	Behaviour, cognition, and personality	The school psychologist notes that many kids who have specific learning disabilities might have behaviour problems because they are frustrated or bored in class, or perhaps they want to distract from the fact that they are doing poorly in class.
Social	Interpersonal, environmental	The teacher claims that Sawyer is showing off in front of the other children and that he thrives on the attention of being the class clown.

Check Your Understanding

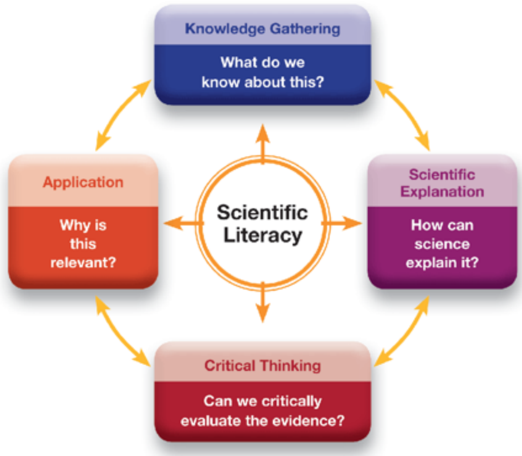
The take-home message of this section is that almost every moment of your life is occurring at all three levels; psychologists have taken up the exciting challenge of trying to understand them. Indeed, behaviour can be fully explained only if multiple perspectives—and their interactions—are investigated. This "systems perspective" will become particularly apparent as you read about psychological research that tackles complex topics.

Building Scientific Literacy

Listen to the Audio

A major aim of this text is to teach you the theoretical foundations, concepts, and applicable skills that are central to the field of psychology. This book is also designed to help you develop **scientific literacy**, *the ability to understand, analyze, and apply scientific information*. As you can see in Figure 1.3, scientific literacy has several key components, starting with the ability to learn new information. Certainly this text will provide you with new terminology and concepts, but you will continue to encounter psychological and scientific terminology long after you have completed this course. Being scientifically literate means that you will be able to read and interpret new terminology, or know where to go to find out more.

Figure 1.3 A Model of Scientific Literacy Does Yoga Relieve Stress?



Scientific literacy involves four different skills: gathering knowledge about the world, explaining it using scientific terms and concepts, thinking critically, and applying this knowledge to relevant, real-world situations.

To make sure you understand the elements of scientific literacy, we should examine a topic step by step. In this example, we will consider the potential benefits of yoga.

1 of 5 Previous Next

Memorizing different terms is not enough to make someone scientifically literate. We also have to examine whether the ideas being presented were scientifically tested, and whether those studies were designed properly. It is absolutely essential that we ask such questions. Doing so allows us to separate the information that we *should* find convincing from the information that we should view with caution. It will also allow you to better analyze the information presented to you by politicians, corporations, and the media; this will make it more difficult for these groups to influence your behaviour. Finally, we want to be able to apply the results of scientific studies to different situations; in other words, to *generalize* the results. Generalization shows us that the studies conducted in universities and hospitals can provide insight into behaviours that extend far beyond the confines of the lab.

Working the Scientific Literacy Model

Planning When to Study

Listen to the Audio

To develop your scientific literacy skills, in every module (beginning with Chapter 2) we will revisit this model and its four components as they apply to a specific psychological topic—a process we call *working the scientific literacy model*. This will help you to move beyond simply learning the vocabulary of psychological research toward *understanding* scientific explanations, thinking critically, and discovering applications of the material. In order to demonstrate how these sections of the text will work, let's use an example that will be familiar to many: planning study time for your classes.

What do we know about timing and studying?

In the first stage of the Scientific Literacy Model, we attempt to gather the available knowledge about the topic that we're investigating, in this case the fact that students differ on how they attempt to remember information for exams. Many students use what is called *massed learning*—they perform all of their studying for an exam in one lengthy session. Another approach is *spaced* or *distributed learning*—having shorter study sessions, but spreading them out over several days. Which technique do you prefer? If you use the massed learning technique (most students prefer it ... or end up using it because they've left studying until

the last minute), it is likely because it *seems* easier and it may even give you the sense that it is more effective than distributed learning. Actually, the two strategies are not equally effective; more than 100 years of memory research has shown us that distributed learning is the better of the two (Cepeda et al., 2006; Edwards, 1917).

How can science explain the effect of timing on study success?

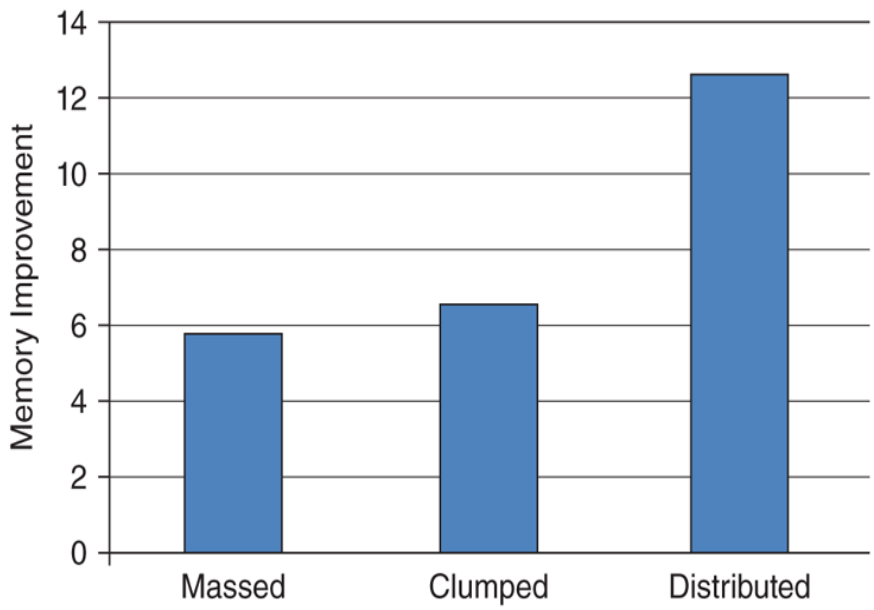
In the second stage of the Scientific Literacy Model, we examine whether the information that is available about a topic has been tested in scientific studies. In a typical study of massed vs. distributed learning, participants are asked to remember lists of words or concepts. The stimuli are presented multiple times. What varies, however, is *when* these presentations occur. In some conditions, the stimuli are presented in a single session (a massed schedule). In other conditions, the studying is spread out across multiple time periods (a spaced or distributed schedule). As early as 1885, Herman Ebbinghaus, a German psychologist, found that his ability to learn sets of nonsense syllables (e.g., wej) was superior if he spread his learning over three days rather than trying to learn the lengthy list in one sitting. Similar patterns of results have been found in hundreds of other studies, providing strong evidence in favour of distributed learning (Delaney et al., 2010; Dempster, 1988). Although there is no single explanation for this effect, one factor is particularly relevant for students. When information is learned in one massed session, it begins to feel repetitive. This leads the learners to pay less attention to the material than they would in distributed learning sessions, when some of the material may have been forgotten (Ausubel, 1966). As a result, people learning in a distributed fashion are more

likely to pay attention to the material than massed learners, a tendency that would obviously improve performance.

Can we critically evaluate this evidence?

In the third stage of the Scientific Literacy Model, we examine the limitations of the studies discussed earlier; we also look for alternative explanations for the results. The most obvious criticism of this research is that results from laboratory-based studies may not reflect how memory works in a real educational setting. This is a valid concern—researchers don't want their effects to be isolated to the laboratory. Luckily, a number of researchers have applied the knowledge and techniques developed by earlier researchers to *applied psychology* studies in the classroom. In one study, elementary school children were taught scientific information about food charts (Gluckman et al., 2014). Each child received four lessons about this topic. One group received all four lessons on a Monday ("massed learning condition"). A second group received two lessons on a Monday and two lessons on a Tuesday ("clumped learning group"). The third group received one lesson per day from Monday through Thursday ("distributed learning group"). All groups were tested one week after their last lesson. As can be seen in Figure 1.4, the distributed learning group retained much more information than the other two groups. Similar patterns of results have been found in studies with middle school children (Sobel et al., 2011) and undergraduate students at an Ontario university (Kapler et al., 2015). The consistent findings across many ages and locations suggests the benefits of distributed learning may apply to many kinds of students in many learning environments.

Figure 1.4 Massed versus Distributed Learning



In a study by Gluckman and colleagues (2014), groups of students learned information in one long session (massed learning), two sessions per day on two consecutive days (clumped learning), or spread across four days (distributed learning). A test one week later found that the distributed learning group retained much more information than the other groups.

Source: Information is derived from Table 1 of Gluckman et al. (2014), Spacing Simultaneously Promotes Multiple Forms of Learning in Children's Science Curriculum, *Applied Cognitive Psychology*, *28*, p. 270, Wiley Online Library.

Why is this finding relevant?

In the final stage of the Scientific Literacy Model, we attempt to apply the results to situations outside of the laboratory. The information about distributed learning is being presented in the first module of this text for a reason: Psychology students should benefit from psychology research. Now that you know that retention is improved if you study over the course of a few days rather than in one long session, you can alter your own study schedule. The benefits to your grades could be substantial. Distributed learning has also proven useful in many clinical contexts, such as helping people improve their memory abilities after suffering a traumatic brain injury (Hillary et al., 2003).

Sometimes simple experiments can have widespread implications; that's something to remember.

Now that you have read this feature, we hope you understand how scientific information fits into the four components of the model. But there is still much to learn about working the model. In the next section, we will describe critical-thinking skills and how to use them.

Critical Thinking, Curiosity, and a Dose of Healthy Skepticism

Listen to the Audio

People are confronted with more information on a daily basis than they have been at any other point in our history. Some of it is credible and can be used to help guide your decisions or behaviour. But we also must deal with claims—often made by people trying to sell you things or convince you that their way of doing things is best. We must keep in mind that these claims are not always true no matter how sophisticated or common sense they may sound.

> "Fish oil supplements can fight off memory problems in old age. They contain omega fatty acids that are vital to nerve cell growth and function."
>
> "How can they say corporal punishment is bad? I was spanked as a kid and I turned out fine!"

Whether in the media or in everyday conversation, misinformation sometimes seems far more abundant than accurate information, which is why it is important to develop critical thinking skills.

Refer to Figure 1.3. As the model shows, critical thinking is an important element of scientific literacy. **Critical thinking** *involves exercising curiosity and skepticism when evaluating the claims of others, and with our own assumptions and beliefs*. Critical thinking does not mean being negative or arbitrarily critical; rather, it means that you intentionally

examine knowledge, beliefs, and the means by which conclusions were obtained.

Critical thinking involves cautious skepticism. We are constantly being told about amazing programs that help us control body weight, improve thinking and memory, enhance sexual performance, and so on. As consumers, there will always be claims we really hope to be true. But as critical thinkers, we meet these claims with a good dose of skepticism (e.g., *Is there sound evidence that this psychological weight-management program helps people to achieve and maintain a healthy body weight?*). Being skeptical can be challenging, especially when it means asking for evidence that we may not want to find. Often the great products or miracle cures that we have always hoped for really *are* "too good to be true." Being curious *and* skeptical leads you to ask important questions about the science underlying such claims. Doing so leads us to search for and evaluate evidence, which is never a bad thing.

Importantly, the ability to think critically can be learned and developed, although most of us need to make a conscious effort to do so (Halpern, 1996). Research points to a core set of habits and skills for developing critical thinking. We will introduce them here, but you will get a more in-depth look at each in the modules indicated below:

1. Be curious. Simple answers are sometimes too simple, and common sense is not always correct (or even close to it). *Example*: Giving your brain some time to rest after having a stroke (a form of brain damage) *hinders* rather than helps your recovery (see Module 3.3).
2. Examine the nature and source of the evidence; not all research is of equal quality. *Example*: Some studies use flawed methods or, in the case of an infamous study linking vaccines and autism, were

performed by someone who would benefit financially if the results told a particular story (see Module 2.3).

3. Examine assumptions and biases. This includes your own assumptions as well as the assumptions of those making the claims. *Example*: Research examining the impact of human behaviour on climate change may be biased if it is funded by oil companies (see Module 2.2).
4. Avoid overly emotional thinking. Emotions can tell us what we value, but they are not always helpful when it comes to making critical decisions. *Example*: you may have strong responses when hearing about differences in the cognitive abilities of males and females (see Module 3.1); however, it is important to put those aside to examine the studies themselves.
5. Tolerate ambiguity. Most complex issues do not have clear-cut answers. *Example*: Psychologists have identified a number of factors leading to depression, but no single factor *guarantees* that a person will suffer from this condition (see Module 15.3).
6. Consider alternative viewpoints and alternative interpretations of the evidence. *Example*: It is clear that we require sleep in order to function properly; however, there are several theories that can explain the functions that sleep serves (see Module 5.1).

Using these critical-thinking skills might seem difficult at first. However, with some practice, they will soon seem like a natural way of viewing the world. They will also help you see through some rather unbelievable stories.

Myths in Mind

Abducted by Aliens!

Independent reports of alien abductions often resemble events and characters depicted in science fiction movies.

Shiva3d/Shutterstock

Occasionally we hear claims of alien abductions, ghost sightings, and other paranormal activity. Countless television shows and movies, both fictional and documentary based, reinforce the idea that these types of events can and do occur. Alien abductions are probably the most far-fetched stories, yet many people believe they occur or at least regard them as a real possibility. What is even more interesting are the extremely detailed accounts given by purported alien abductees. However, physical evidence of an abduction is always lacking. So what can we make of the validity of alien abduction stories?

Scientific and critical thinking involve the use of the **principle of parsimony**, which states that *the simplest of all competing explanations (the most "parsimonious") of a phenomenon should be the one we accept*. Is there a simpler explanation for alien abductions? Probably. Psychologists who study alien abduction cases have discovered some interesting patterns.

First, historical reports of abductions typically spike just after the release of science fiction movies featuring space aliens. Details of the reports often follow specific details seen in these movies (Clancy, 2005). Second, it probably would not be too surprising to learn that people who report being abducted are prone to fantasizing and having false memories (vivid recollection and belief in something that did not happen; Lynn & Kirsch, 1996; Spanos et al., 1994). Finally, people who claim to have been abducted are likely to experience sleep paralysis (waking up and becoming aware of being unable to move—a temporary state that is not unusual) and hallucinations while in the paralyzed state (McNally et al., 2004). You can likely see how these three factors could explain reports of alien abductions. Following the principle of parsimony typically leads to real, though sometimes less spectacular, answers—although these answers might leave the so-called “abductees” feeling alienated.

Module 1.1 Summary

Listen to the Audio

1.1a Know . . . the key terminology of the scientific method.

Review Module 1.1

Start Over | Swap

0/10 REVIEWED · 0 MASTERED

theory

Previous | Next | Got It!

1.1b Understand . . . the steps of the scientific method.

The basic model in Figure 1.1 guides us through the steps of the scientific method. Scientific theories generate hypotheses, which are specific and testable predictions. If a hypothesis is confirmed, new hypotheses may stem from it, and the original theory receives added

support. If a hypothesis is rejected, the original hypothesis may be modified and retested, or the original theory may be modified or rejected.

1.1c Understand . . . the concept of scientific literacy.

Scientific literacy refers to the process of how we think about and understand scientific information. The model for scientific literacy was summarized in Figure 1.3. Working the model involves answering a set of questions:

What do we know about a phenomenon?

How can science explain it?

Can we critically evaluate the evidence?

Why is this relevant?

You will see this model applied to concepts in each chapter of this text. This includes gathering knowledge, explaining phenomena in scientific terms, engaging in critical thinking, and knowing how to apply and use your knowledge.

1.1d Apply . . . the biopsychosocial model to behaviour.

This is a model we will use throughout the text. As you consider each topic, think about how biological factors (e.g., the brain and genetics) are influential. Also consider how psychological factors such as thinking, learning, emotion, and memory are relevant. Social and cultural factors complete the model. These three interacting factors influence our behaviour.

1.1e Apply . . . the steps in critical thinking.

To be useful, critical thinking is something not just to memorize, but rather to use and apply. Remember, critical thinking involves (1) being curious, (2) examining evidence, (3) examining assumptions and biases, (4) avoiding emotional thinking, (5) tolerating ambiguity, and (6) considering alternative viewpoints. Try applying these steps in the activity below.

Apply Activity Applying Critical Thinking

Practise applying critical thinking skills to the following scenario.

CountOff is an interactive program that helps you get the weight off and keep it off. Whether you want to lose a little or a lot, you probably alreay know that it can be challenging; keeping it off is even harder. But it doesn't have to be.

Using the CountOff app is like having a peronsal trainer with you. It helps you count your calories and macronutrients to see what you're taking in. It also counts the calories you expend by interacting with your mobile phone or other wearable fitness device. This makes weight control so simple, you won't have to give it a second thought! Studies show that tracking diet and activity increases motivation, reducing the likelihood of giving up or putting the weight back on. Tracking activity shows how much you are burning off. And most important, being patient and losing 2kg a month allows you to establish a new relationship with eating and keep your weight off. That's something you can count on.

Critical Thinking Questions

Compare your answers with others.

1.1f Analyze . . . the use of the term *scientific theory*.

As you read in this module, the term *theory* is often used very casually in the English language, sometimes synonymously with *opinion*. Thus, it is important to analyze the scientific meaning of the term and contrast it with the alternatives. A scientific theory is an explanation for a broad range of observations, integrating numerous findings into a coherent

whole. Remember, theories are not the same thing as opinions or beliefs, all theories are not equally plausible, and, strange as it may sound, the quality of a scientific theory is not determined by the number of people who believe it to be true.

Module 1.2 How Psychology Became a Science

Listen to the Audio

Nagib/Shutterstock

Learning Objectives

1.2a Know . . . the key terminology of psychology's history.

1.2b Understand . . . how various philosophical and scientific fields became major influences on psychology.

1.2c Apply . . . your knowledge to distinguish among the different specializations in psychology.

1.2d Analyze . . . how the philosophical ideas of empiricism and determinism are applied to human behaviour.

When we try to imagine the earliest investigations of human behaviour, we rarely think about axe wounds to the head. As it turns out, we should. The ancient Egyptians were a fierce military force for several millennia. The wealth accumulated during these military campaigns filled the palaces of the pharaohs with gold and jewels and allowed them to construct massive monuments like the pyramids. But one side effect of having many battles was that members of the Egyptian army also suffered many injuries, including some to the head. Although the primitive medical knowledge of the time condemned most brain-injured patients to death, some did in fact survive and attempted to return to their normal lives. However, as one might expect when someone has suffered an axe (khopesh) *wound to the head, such attempts were not always successful. Similar problems had likely occurred in earlier times, but what makes ancient Egypt stand out is that military doctors noticed —and documented—*patterns *that emerged in their patients. As noted in the Edwin Smith papyrus (obviously named after the American discoverer, not the Egyptian authors), damage to different parts of the brain resulted in different types of impairments ranging from problems with vision to problems with higher-order cognitive abilities. Although primitive by modern standards, this initial attempt to link a brain-*

based injury to a change in behaviour marked the first step toward our modern study of psychology.

Psychology has long dealt with some major questions and issues that span philosophical inquiry and scientific study. For example, psychologists have questioned how environmental, genetic, and physiological processes influence behaviour. They have wrestled with the issue of whether our behaviour is determined by external events, or if we have free will to act. Psychology's search for answers to these and other questions continues, and in this module we put this search into historical context and see how these questions have influenced the field of psychology as it exists today.

Psychology’s Philosophical and Scientific Origins

Listen to the Audio

Science is more than a body of facts to memorize or a set of subjects to study. Science is actually a philosophy of knowledge that stems from two fundamental beliefs: empiricism and determinism.

Empiricism *is a philosophical tenet that knowledge comes through experience*. In everyday language, you might hear the phrase “Seeing is believing,” but in the scientific sense, empiricism means that knowledge about the world is based on careful observation, not on common sense or speculation. Whatever we see or measure should be observable by anyone else who follows the same methods. In addition, scientific theories must be logical explanations of how the observations fit together. Thus, although the empiricist might say, “Seeing is believing,” thinking and reasoning about observations are just as important.

Determinism *is the belief that all events are governed by lawful, cause-and-effect relationships*. This is easy enough when we discuss natural laws such as gravity—we probably all agree that if you drop a heavy object, it will fall—it has no say in the matter. But does the lawfulness of nature apply to the way we humans think and act? This opens the philosophical debate between *free will* and *determinism*. While we certainly feel as if we are in control of our own behaviours—that is, we sense that we have free will—there are compelling reasons to believe that some of our behaviours are determined. For example, when a doctor taps your patellar tendon below

your kneecap, your leg moves without waiting for "you" to decide. The level of determinism or free will psychologists attribute to humans is certainly debated, and to be a psychologist, you do not have to believe that every single thought, behaviour, or experience is determined by natural laws. But psychologists certainly do recognize that behaviour is determined by both internal (e.g., genes, brain chemistry) and external (e.g., cultural) influences.

Psychological science is both empirical and deterministic. We now know that behaviour can only be understood by making observations and testing hypotheses. We also know that behaviour occurs at several levels, ranging from cells to societies. However, this modern knowledge did not appear overnight. Instead, our understanding of why we behave the way we do is built upon the hard work, creativity, and astute observational powers of scientists throughout history dating (at least) as far back as the ancient Mediterranean societies of Egypt, Greece, and Rome.

Influences from the Ancients: Philosophical Insights into Behaviour

Listen to the Audio

As you read in the opening section of this module, ancient Egyptian doctors noticed that damage to different brain areas led to vastly different impairments. While such an observation marked the first recorded linking of biology and behaviour, it was not the only important insight to come out of ancient societies.

In ancient Greece, the physician Hippocrates (460–370 BCE) developed the world's first personality classification scheme. The ancient Greeks believed that four *humours* or fluids flowed throughout the body and influenced both health and personality. These four humours included blood, yellow bile, black bile, and phlegm (theories were a bit gross in ancient times). Different combinations of these four humours were thought to lead to specific moods and behaviours. Galen of Pergamon (127–217 CE), arguably the greatest of the ancient Roman physicians, refined Hippocrates's more general work and suggested that the four humours combined to create *temperaments*, or emotional and personality characteristics that remained stable throughout the lifetime. Galen's four temperaments (each related to a humour) included:

- *Sanguine* (blood), a tendency to be impulsive, pleasure-seeking, and charismatic;
- *Choleric* (yellow bile), a tendency to be ambitious, energetic, and a bit aggressive;

- *Melancholic* (black bile), a tendency to be independent, a perfectionistic, and a bit introverted; and
- *Phlegmatic* (phlegm), a tendency to be quiet, relaxed, and content with life.

Although such a classification system is primitive by modern standards, the work of Hippocrates and Galen moved the understanding of human behaviour forward by attempting to categorize different types of personalities; we will see much more scientifically rigorous attempts to do the same thing later in this book (see Module 12.1). However, the golden age of Greek and Roman thought came to a crashing halt in the latter part of the fourth century; this was the beginning of the Dark Ages. Although some discoveries were made about human anatomy during this period, few notable advances in the study of behaviour were made over the next one thousand years.

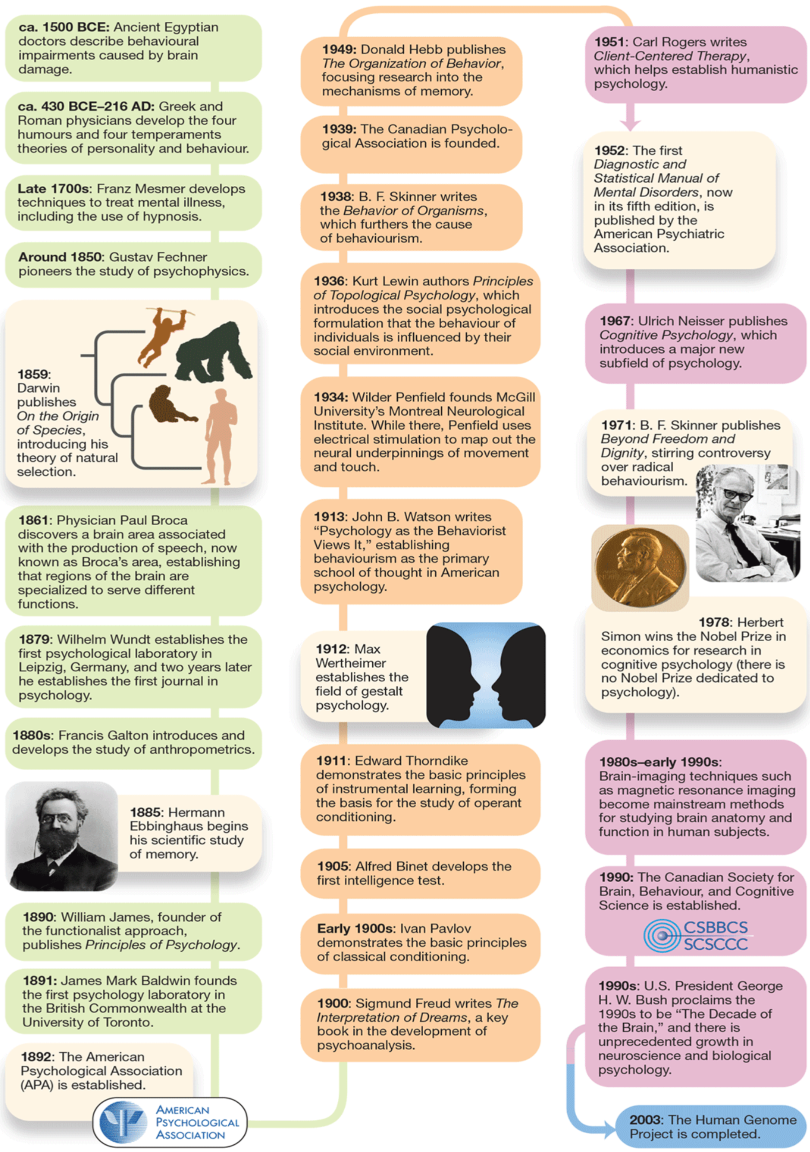
Psychology also did not immediately benefit from the scientific revolution of the 1500s and 1600s. Once the scientific method started to take hold around 1600, physics, astronomy, physiology, biology, and chemistry all experienced unprecedented growth in knowledge and technology. But it took psychology until the late 1800s to become scientific. Why was this the case? One of the main reasons was *zeitgeist*, a German word meaning "spirit of the times." **Zeitgeist** *refers to a general set of beliefs of a particular culture at a specific time in history*. It can be used to understand why some ideas take off immediately, whereas other perfectly good ideas may go unnoticed for years.

The power of zeitgeist can be very strong, and there are several ways it prevented psychological science from emerging in the 1600s. Perhaps most important is that people were not ready to accept a science that could be applied to human behaviour and thought. To the average person of the 1600s, viewing human behaviour as the result of predictable

physical laws was troubling. Doing so would seem to imply the philosophy of **materialism**: *the belief that humans, and other living beings, are composed exclusively of physical matter*. Accepting this idea would mean that we are nothing more than complex machines that lack a self-conscious, self-controlling soul. The opposing belief, *that there are properties of humans that are not material (a mind or soul separate from the body)*, is called **dualism**.

Although most early thinking about the mind and behaviour remained philosophical in nature, scientific methods were generating great discoveries for the natural sciences of physics, biology, and physiology. This meant that the early influences on psychology came from the natural and physical sciences. (Figure 1.5 provides a timeline that summarizes some of the major events in the history of psychology.)

Figure 1.5 Major Events in the History of Psychology



Left, centre: Bettmann/Corbis; left, bottom: The APA logo is a trademark of the American Psychological Association. Reproduced with permission. No further reproduction or distribution is permitted without written permission from the American Psychological Association; centre: pio3/Shutterstock.com; right, centre (right): AP Images; right, centre (left): Science and Society/SuperStock; right, bottom: Copyright © by The Canadian Society for Brain, Behaviour and Cognitive Science (CSBBCS). Reprinted by permission.

Influences from Physics: Experimenting with the Mind

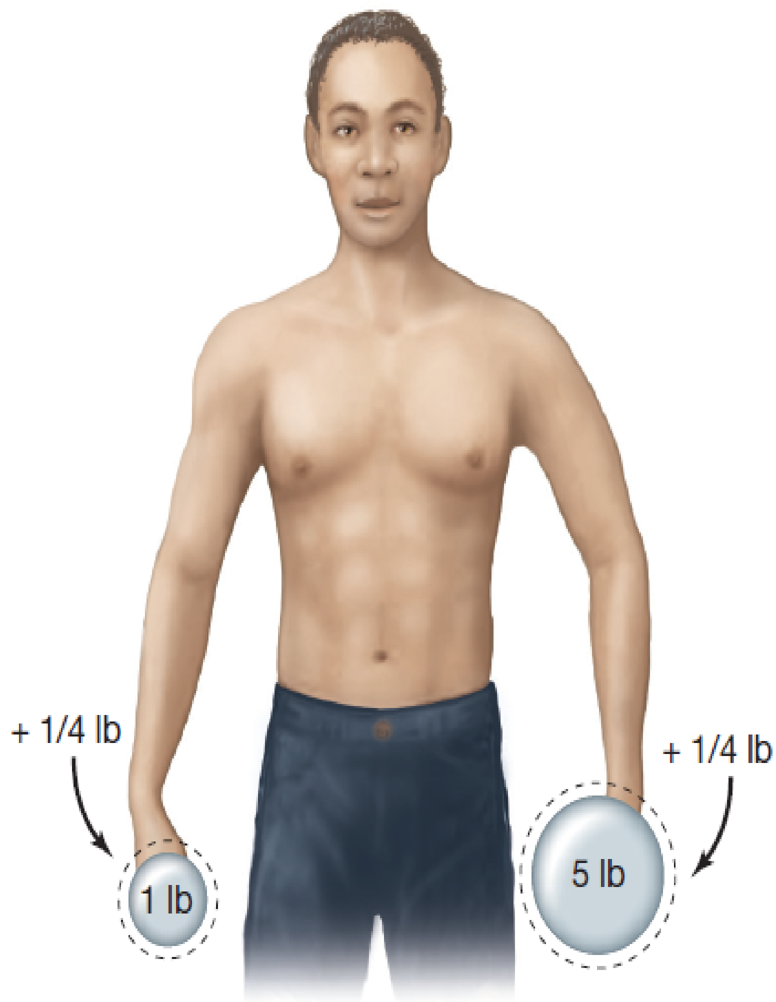
Listen to the Audio

The initial forays into scientific psychology were conducted by physicists and physiologists. One of the earliest explorations was made by Gustav Fechner (1801–1887), who studied sensation and perception (see Module 4.1). As a physicist, Fechner was interested in the natural world of moving objects and energy. He turned his knowledge to psychological questions about how the physical and mental worlds interact. Fechner coined the term **psychophysics**, *which is the study of the relationship between the physical world and the mental representation of that world*.

As an example of psychophysical research, imagine you are holding a one-pound (0.45 kg) weight in your right hand and a five-pound (2.27 kg) weight in your left hand. Obviously, your left hand will feel the heavier weight, but that is not what interested Fechner. What if a researcher places a quarter-pound weight (113 g) in each hand, resting on top of the weight that is already there? Fechner wanted to know which of the quarter-pound weights would be perceived as heavier. Oddly enough, although both weigh the same amount, the quarter-pound weight in your right hand will be more noticeable than the quarter-pound weight added to your left hand, almost as if it were heavier (see Figure 1.6). Through experiments like these, Fechner demonstrated basic principles of how the physical and mental worlds interact. In fact, he developed an equation to precisely calculate the *perceived* change in weight, and then extended this formula to apply to changes in brightness, loudness, and other perceptual

experiences. This work served as the foundation for the modern study of perception.

Figure 1.6 The Study of Psychophysics

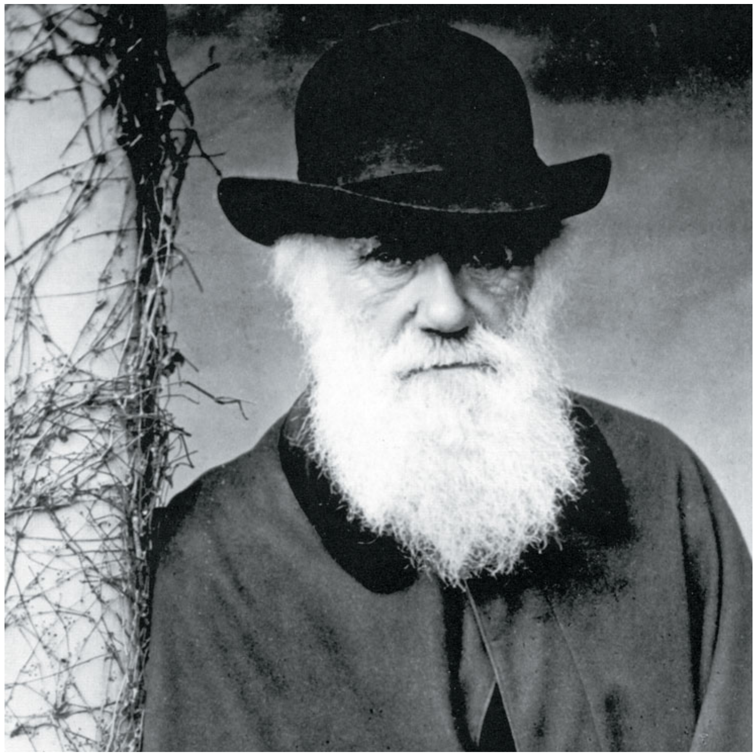


Gustav Fechner studied relationships between the physical world and our mental representations of that world. For example, Fechner tested how people detect changes in physical stimuli.

Influences from Evolutionary Theory: The Adaptive Functions of Behaviour

Listen to the Audio

Around the same time Fechner was doing his experiments, Charles Darwin (1809–1882) was studying the many varieties of plants and animals found around the world. Darwin noticed that animal groups that were isolated from one another often differed by only minor variations in physical features. These variations seemed to fine-tune the species according to the particular environment in which they lived, making them better equipped for survival and reproduction. Darwin's theory of evolution by *natural selection* was based on his observations that the genetically inherited traits that contribute to survival and reproductive success are more likely to flourish within the breeding population (i.e., useful traits will be passed on to future generations). These specific traits differ across locations because different traits will prove beneficial in different environments. This theory explains why there is such a diversity of life on Earth.



Charles Darwin proposed the theory of natural selection to explain how evolution works.

Pictorial Press Ltd/Alamy Stock Photo

Darwin's theory also helps to explain human (and animal) behaviour. As Darwin pointed out in *The Expression of the Emotions in Man and Animals* (1872), behaviour is shaped by natural selection, just as physical traits are (see Module 3.1). Over the course of millions of years of evolution, a certain range of behaviours helped our ancestors survive and reproduce. The modern behaviours that we engage in every day—memory, emotions, forming social bonds, and so on—were the same behaviours that allowed our ancestors to flourish over the course of our species' history. The same principle applies to other species as well. Darwin's recognition that behaviours, like physical traits, are subject to hereditary influences and natural selection was a major contribution to psychology.

Influences from Medicine: Diagnoses and Treatments

Listen to the Audio

Medicine contributed a great deal to the biological perspective in psychology. It also had a considerable influence on the development of **clinical psychology**, *the field of psychology that concentrates on the diagnosis and treatment of psychological disorders*. A research topic that impacted both fields was the study of **localization of brain function**, the idea that certain parts of the brain control specific mental abilities and personality characteristics.

In the mid-1800s, localization was studied in two different ways. The first was *phrenology*, which gained considerable popularity for more than 100 years thanks to physicians Franz Gall (1758–1828)and Johann Spurzheim (1776–1832). Gall, Spurzheim, and their followers believed that the brain consisted of 27 "organs," corresponding to mental traits and dispositions that could be detected by examining the surface of the skull. Although it seems silly now, there was a logic behind phrenology. Its supporters believed that different traits and abilities were distributed across different regions of the brain (e.g., "combativeness" was located at the back of the brain behind the ears). If a person possessed a particular trait or ability, then the brain area related to that characteristic would be larger in the same way that the muscles in your arms would be larger if your job required you to lift things. Larger brain areas would cause bumps on a person's head in the same way that a muscular arm could cause the fabric of a shirt to stretch. So, by measuring the bumps on a person's head,

proponents of phrenology believed that it would be possible to identify the different traits that an individual possessed. Phrenology continued to gather supporters for nearly a century before being abandoned by serious scientists. You may have encountered images of the phrenological map of the skull (see Figure 1.7).

Figure 1.7 A Phrenology Map

Early scholars of the brain believed that mental capacities and personalities could be measured by the contours, bumps, and ridges distributed across the surface of the skull.

Classic Image/Alamy Stock Photo

The other approach to localization entailed the study of brain injuries and the ways in which they affect behaviour. This work had a scientific grounding that phrenology lacked. There were many intriguing cases described by physicians of the 1800s. For example:

- Physician Paul Broca found that a patient who had difficulties producing spoken language had brain damage in an area of the left frontal lobes of brain (near his left temple).
- Prussian physician Karl Wernicke found that damage to another area in the left hemisphere led to problems comprehending language.
- Doctors in Vermont described a railway employee who became impulsive and somewhat childlike after suffering damage to part of his frontal lobes.

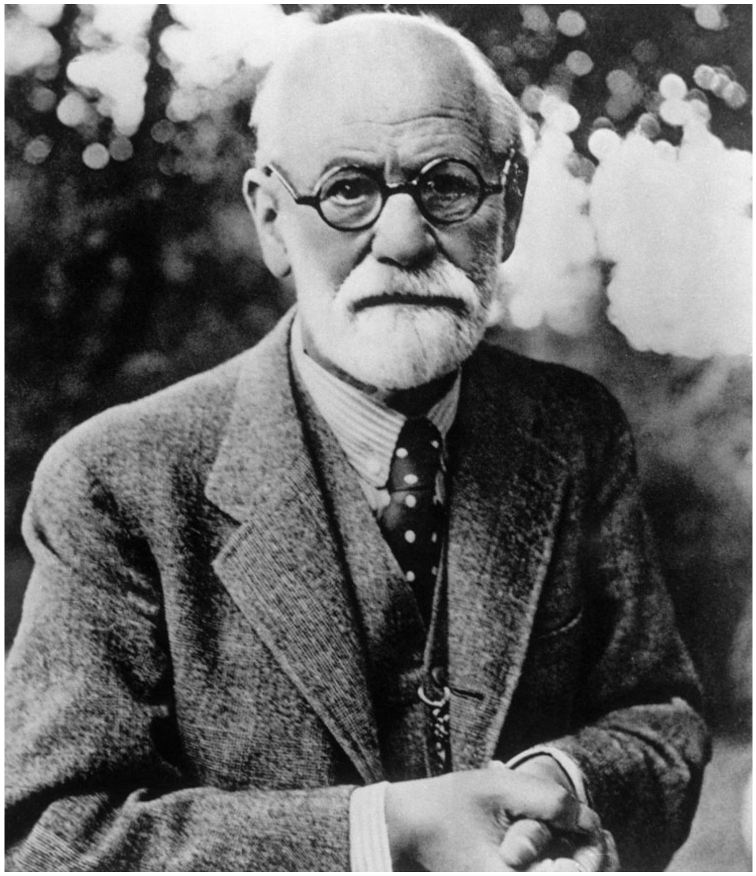
These compelling clinical cases provided early brain researchers with new information about the roles of different brain areas, findings that are still relevant today.

Of course, the influence of the medical perspective was not isolated to studies of the localization of brain function. Additional medical influences on psychology came from outside of mainstream practices. Franz Mesmer, an 18th-century Austrian physician practising in Paris, believed that prolonged exposure to magnets could redirect the flow of metallic fluids in the body, thereby curing disease and insanity. Although his claim was rejected outright by the medical and scientific communities in France, some of his patients seemed to be cured after being lulled into a trance. Modern physicians and scientists attribute these "cures" to the patients' belief in the treatment—something we will describe in Chapter 2 as the *placebo effect*.

The medical establishment eventually grew more intrigued by the trances Mesmer produced in his patients, naming the phenomenon *hypnosis* (see Module 5.2). This practice also caught the attention of an Austrian physician named Sigmund Freud (1856–1939), who began to use hypnosis to treat his own patients. Freud was particularly interested in how hypnosis seemed to have cured several patients of *hysterical paralysis*—a condition in which an individual loses feeling and control in a specific

body part, despite the lack of any known neurological damage or disease. These experiences led Freud to develop his famous theory and technique called psychoanalysis.

Psychoanalysis *is a psychological approach that attempts to explain how behaviour and personality are influenced by unconscious processes*. Freud acknowledged that conscious experience includes perceptions, thoughts, a sense of self, and the sense that we are in control of ourselves. However, he also believed in an unconscious mind that contained forgotten episodes from early childhood as well as urges to fulfill self-serving sexual and aggressive impulses. Freud proposed that because these urges were unconscious, they could exert influence in strange ways, such as restricting the use of a body part (i.e., hysterical paralysis). Freud believed hypnosis played a valuable role in his work. When a person is hypnotized, dreaming, or perhaps medicated into a trancelike state, he thought, the psychoanalyst could have more direct access into the individual's unconscious mind. Once Freud gained access, he could attempt to determine and correct any desires or emotions he believed were causing the unconscious to create the psychosomatic conditions.



Sigmund Freud developed the concept of an unconscious mind and its underlying processes in his theory of psychoanalysis.

Chronicle/Alamy Stock Photo

Although Freud did not conduct scientific experiments, his legacy can be seen in some key elements of scientific psychology. First, many modern psychologists make inferences about unconscious mental activity, just as Freud had advocated (although not all of them agree with the specific theories proposed by Freud). Second, the use of medical ideas to treat disorders of emotions, thought, and behaviour—an approach known as the *medical model*—can be traced to Freud's influence. Third, Freud incorporated evolutionary thinking into his work; he emphasized how physiological needs and urges relating to survival and reproduction can influence our behaviour. Finally, Freud placed great emphasis on how early life experiences influence our behaviour as adults—a perspective

that comes up many times in this text. So, although people often mock some of his theories, Freud's impact on modern psychology is deserving of respect.

The Influence of Social Sciences: Measuring and Comparing Humans

Listen to the Audio

A fifth influential force came out of the social sciences of economics, sociology, and anthropology. These disciplines developed statistical methods for measuring human traits, which soon became relevant to the emerging field of psychology. An early pioneer in measuring perception and in applying statistical analyses to the study of behaviour was Sir Francis Galton.

Galton was also influential in the study of individual differences between people. He noticed that great achievement tended to run in families; as a result, Galton came to believe that heredity (genetics) could explain the physical and psychological differences found in a population. After all, Galton's cousin—some guy named Charles Darwin—was a great naturalist, his uncle Erasmus was a celebrated physician and writer, and Galton himself was no slouch (he began reading as a two-year-old child, and was a fan of Shakespeare by age six). To Galton, it seemed natural that people who did better in scholarship, business, and wealth were able to do so because they were *better* people (genetically speaking).

To support his beliefs, Galton developed ways of measuring what he called *eminence*—a combination of ability, morality, and achievement. One observation supporting his claim for a hereditary basis for eminence was that the closer a relative, the more similar the traits. Galton was one of the first investigators to scientifically take on the question of **nature**

and nurture relationships, *the inquiry into how heredity (nature) and environment (nurture) influence behaviour and mental processes*. Galton came down decidedly on the nature side, seemingly ignoring the likelihood that nurturing influences such as upbringing and family traditions, rather than biological endowments, could explain similarities among relatives.

Galton's beliefs and biases led him to pursue scientific justification for *eugenics*, which literally translates as "good genes." He promoted the belief that social programs should encourage intelligent, talented individuals to have children, whereas criminals, those with physical or mental disability, and non-White races should not receive such encouragement (see Module 9.1). The eugenics movement was based largely on what the researchers wanted to believe was true, not on quality research methods. It ultimately led to the mistreatment of many individuals, particularly immigrants and the descendants of slaves who were not of Galton's own demographic group. It also influenced the thinking of Adolf Hitler, with chilling consequences.

In modern times, biological and genetic approaches to explaining behaviour are thriving (and, thankfully, eugenics has vanished). With the advent of new brain-imaging techniques, this area of psychology—*biological psychology*—is poised to provide new and important insights into the underlying causes of our behaviour.

The Beginnings of Contemporary Psychology

Listen to the Audio

Before psychology became its own discipline, there were scientists working across different fields who were converging on a study of human behaviour. By modern standards, Darwin, Fechner, and others had produced psychological research but it was not referred to as such because the field had not yet fully formed. Nevertheless, progress toward a distinct discipline of psychology was beginning.

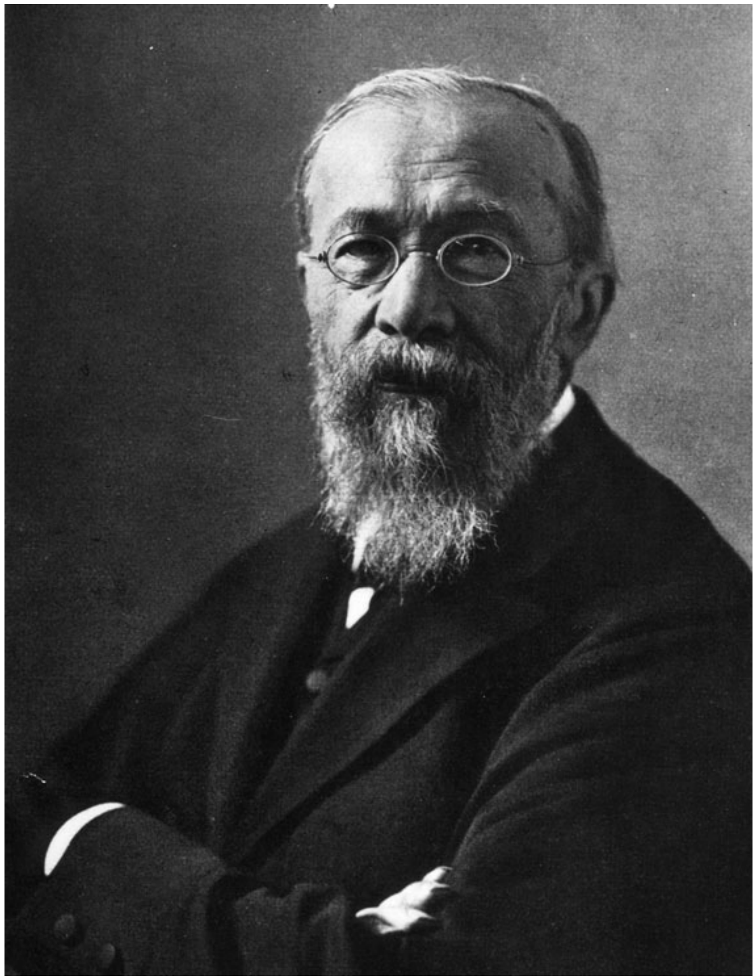
By the late 1800s, the zeitgeist had changed so that the study of human behaviour was acceptable. Ideas flourished. Most importantly, researchers began to investigate behaviour in a number of different ways. You will see this breadth as you read the rest of this module. We will include references to other modules (e.g., see Module 6.1) to illustrate that the history that you are reading in this module had a direct effect on the modern understanding of behaviour that you will read about in the rest of this text.

Structuralism and Functionalism: The Beginnings of Psychology

Listen to the Audio

Most contemporary psychologists agree that Wilhelm Wundt (1832–1920) was largely responsible for establishing psychology as an independent scientific field. Wundt established the first laboratory dedicated to studying human behaviour in 1879 at the University of Leipzig, where he conducted numerous experiments on how people sense and perceive. His primary research method was *introspection*, meaning "to look within." Introspection required a trained volunteer to experience a stimulus and then report each individual sensation he or she could identify. For example, if the volunteer was given a steel ball to hold in one hand, he would likely report the sensations of cold, hard, smooth, and heavy. To Wundt, these basic sensations were the mental "atoms" that combined to form the molecules of experience. Wundt also developed *reaction time* methods as a way of measuring mental effort. In one such study, volunteers watched an apparatus in which two metal balls swung into each other to make a clicking sound. The volunteers required about one-eighth of a second to react to the sound, leading Wundt to conclude that mental activity is not instantaneous, but rather requires a small amount of effort measured by the amount of time it takes to react. What made Wundt's work distinctly psychological was his focus on measuring mental events and examining how they were affected by his experimental manipulations.

Wundt's ideas made their way to the United States and Canada through students who worked with him. However, whereas Wundt's research often attempted to link a person's perceptions with concepts such as free will (a philosophy known as *voluntarism*), many of his students wanted to move psychological research in a different direction (Rieber & Robinson, 1980). One student, Edward Titchener, adopted the same method of introspection used by Wundt to devise an organized map of the structure of human consciousness. His line of research, **structuralism**, *was an attempt to analyze conscious experience by breaking it down into basic elements, and to understand how these elements work together*. Titchener chose the term *elements* deliberately as an analogy with the periodic table in the physical sciences. He believed that mental experiences were made up of a limited number of sensations, which were analogous to elements in physics and chemistry. According to Titchener, different sensations can form and create complex compounds, just like hydrogen and oxygen can combine to form water—H_2O—or the hydroxide ion—OH. The challenge for psychologists was to determine which elements were grouped together during different conscious experiences and to figure out what caused these specific groupings to occur (Titchener, 1898).



German scientist Wilhelm Wundt is widely credited as the founder of experimental psychology.

AKG Images/Newscom

The same year Wundt set up his first laboratory, an American scholar named William James (1842–1910) set out to write the first textbook in psychology, *The Principles of Psychology*, which was eventually published in 1890. Trained as a physician, James combined his knowledge of physiology with his interest in the philosophy of mental activity. Among his many interests, he sought to understand how the mind functions. In contrast to structuralism, which looks for permanent, unchanging elements of thought, James was influenced by Darwin's evolutionary principles; he preferred to examine behaviour in context and explain how

our thoughts and actions help us adapt to our environment. This led to the development of **functionalism**, *the study of the purpose and function of behaviour and conscious experience*. According to functionalists, in order to fully understand a behaviour, one must try to figure out what purpose it may have served over the course of our evolution. These principles are found today in the modern field of *evolutionary psychology*, an approach that interprets and explains modern human behaviour in terms of forces acting upon our distant ancestors (see Module 3.1). According to this approach, our brains and behaviours have been shaped by the physical and social environment that our ancestors encountered. Over the next century, this idea was extended to a number of subfields in psychology ranging from the study of brain structures to the study of social groups. Indeed, regardless of their research area, most psychologists are still fascinated by the question, *What function does the behaviour we're investigating serve?* In other words, *why* do we behave the way we do?

Margaret Floy Washburn was intrigued by Wundt's structuralism, and became an innovator in comparative psychology. Not only was she the first woman granted a PhD in psychology, she was one of the most prolific scientists of her time.

Alamy Stock Photo

During the early years of psychology, the pioneers of this field were trying to find a way to use the methods and instruments of the natural sciences to understand behaviour. Although some of their techniques fell out of favour, by the beginning of the 20th century it was clear that the discipline of psychology was here to stay. With that sense of permanence in place, the second generation of psychologists could focus on refining

the subject matter and the methods, and on turning psychology into a widely accepted scientific field.

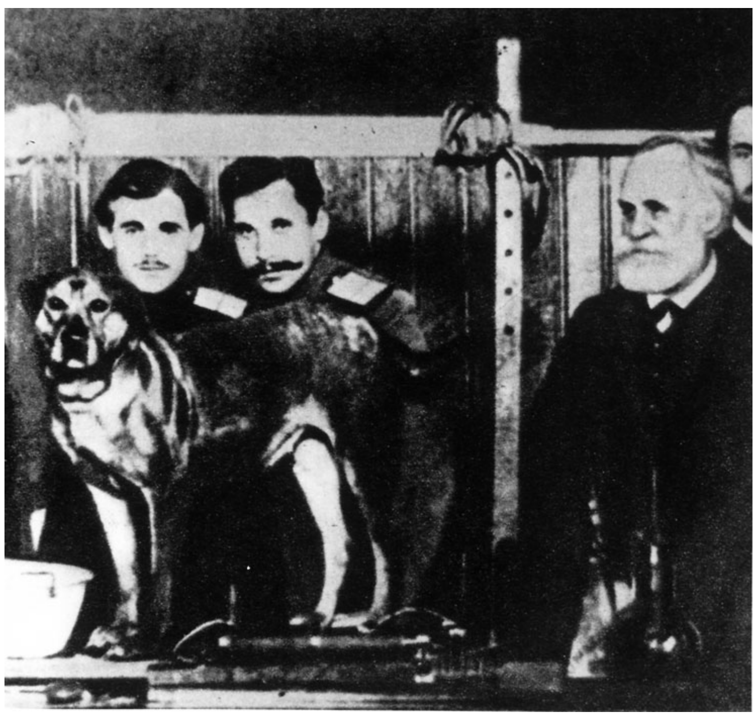
The Rise of Behaviourism

Listen to the Audio

Early in the 20th century, scientists became interested in how organisms learn to anticipate their bodily functions and responses. One of the first to do so was Edwin Twitmyer (1873–1943), an American psychologist interested in reflexes. His work involved a contraption with a rubber mallet that would regularly tap the patellar tendon just below the kneecap; this, of course, causes a kicking reflex in most individuals. To make sure his volunteers were not startled by the mallet, the contraption would ring a bell right before the mallet struck the tendon. As is often the case in experiments, the technology failed after a number of these bell-ringing and hammer-tapping combinations: The machine rang the bell, but the hammer did not come down on the volunteer's knee. But the real surprise was this—the volunteer's leg kicked anyway! How did that happen? Because the sound of the bell successfully predicted the hammer, the ringing soon had the effect of the hammer itself, a process now called *classical conditioning* (see Module 6.1). The study of conditioning would soon become a focus of **behaviourism**, *an approach that dominated the first half of the 20th century of North American psychology and had a singular focus on studying only observable behaviour, with little to no reference to mental events or instincts as possible influences on behaviour*.

Twitmyer's research was coolly received when he announced his findings at the American Psychological Association meeting. Not a single colleague bothered to ask him a question. The credit for discovering classical conditioning typically goes to a Russian physiologist named Ivan

Pavlov (1849–1936). Pavlov, who won the 1904 Nobel Prize for his research on the digestive system, noticed that the dogs in his laboratory began to salivate when the research technician entered the room and turned on the device that distributed the meat powder (food). Importantly, salivation occurred *before* the delivery of food, suggesting that the dogs had learned an association between the technician and machine noises and the later appearance of food. This observation quickly led to more focused research on mechanisms of learning; the principles of learning that Pavlov and others identified provided a foundation for the behaviourist movement.



Ivan Pavlov (on the right) explained classical conditioning through his studies of salivary reflexes in dogs.

Time Life Pictures/Mansell/The LIFE Picture Collection/Getty Images

In North America, behaviourism was championed by John B. Watson, a researcher at Johns Hopkins University in Baltimore (1878–1958). As research accumulated on the breadth of behaviours that could be

conditioned, Watson began to believe that all behaviour could ultimately be explained through conditioning. This emphasis on learning also came with stipulations about what could and could not be studied in psychology. Watson was adamant that only observable changes in the environment and behaviour were appropriate for scientific study. Methods such as Wundt's introspection, he said, were too subjective to even consider:

> *Psychology as the behaviorist views it is a purely objective natural science. Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods*. (Watson, 1913, p. 158)

In the diplomatic world of science, this statement was akin to carving "Wundt sucks!" in a park bench. Watson believed so much in the power of experience (and so little in the power of genetics) that he was certain he could engineer a personality however he wished, if given enough control over the environment. Perhaps his most famous statement sums it up:

> *Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors*. (Watson, J. B. (1930). Behaviorism. Chicago: University of Chicago Press. p. 82)

As you can see, Watson led the behaviourist movement with a level of confidence that some would describe as unwarranted and arrogant. The important takeaway message, however, is that this rigorous, behaviourist approach to psychology led to important scientific insights in the laboratory, as well as some interesting applications in the real world.

In addition to leading the charge for a more objective psychological science, Watson also explored the connection between scientific research (collecting data and testing theories) and application (using psychology to

solve real problems and improve lives). It is important to see that the real-world applications of psychology stem from quality research, just as you should see how even very basic research can lead to applications. To emphasize the connection between research and application, we will present this Psych@ feature once in every chapter. In this case, we will tell you about how John B. Watson took research from the lab and applied it to business.

Psych@

The Advertising Agency

After a rather public indiscretion involving a female graduate student (due to his wife's social status, his extramarital affair appeared on the front page of the Baltimore newspapers; Fancher, 1990), Watson was dismissed from his university job. But he quickly found his new career—as well as his fortune—in advertising. Most advertisers at the time just assumed they should inform people about the merits of a product. Watson and his colleagues applied a scientific approach to advertising and discovered a consumer's knowledge about the product really was not that important, so long as he or she had positive emotions associated with it. Thus, Watson's company developed ads that employed behaviourist principles to form associations between a product's brand image and positive emotions. If Pavlov's dogs could be conditioned to salivate when they heard a tone, what possibilities might there be for conditioning humans in a similar way?Modern advertisers want the logos for their brands of snacks or the trademark signs for their restaurants to bring on a specific craving, and some salivation along the way. And so, from beer commercials with

scantily clad women dancing at parties, to car commercials with high-intensity music and vistas of the Cabot Trail, and from impossibly cute kittens playing with toilet paper rolls to giant billboards of bunnies and hippos pitching telecommunications products, the influence of John B. Watson and his colleagues on modern advertising is felt every day.

Radical Behaviourism

Listen to the Audio

The study of learning was not limited to classical conditioning. As early as 1905, psychologists such as Edward Thorndike (1874–1949) had shown that the frequency of different behaviours could be changed based on whether or not that behaviour led to positive consequences or "satisfaction" (Thorndike, 1905). Taking up the reins from Thorndike was B. F. Skinner (1904–1990), another behaviourist who had considerable influence over North American psychology for several decades (see Module 6.2).

In Skinner's view, known as *radical behaviourism*, the foundation of behaviour was how an organism responded to rewards and punishments. This theory is logical in many ways—we tend to repeat actions that are rewarded (e.g., studying for exams leads to better grades, so we study for other exams) and avoid actions that lead to punishment (e.g., if you vomit after eating a 2L container of ice cream, you will be unlikely to do so again . . . for a while). In order to identify the principles of reward and punishment, Skinner opted to use a tightly controlled experimental setup involving animals such as rats and pigeons. Typically, these studies occurred with animals held in small chambers in which they could manipulate a lever to receive rewards. The experimenter would control when rewards were available, and would observe the effects that changing the reward schedule had on the animals' behaviour. You might ask what this work had to do with human behaviour. The behaviourists believed that the principles of reward and punishment could apply to all

organisms, both human and nonhuman. Indeed, Watson explicitly stated that behaviourist psychology “recognizes no line between man and brute” (Watson, 1913, p. 158).

B. F. Skinner revealed how rewards affect behaviour by conducting laboratory studies on animals.

Nina Leen/The LIFE Picture Collection/Getty Images

Social and Cultural Influences

Listen to the Audio

The vast majority of behaviourist and cognitive psychology research focuses on an individual's responses to some sort of stimulus. Missing from this equation, however, is that fact that people often have to respond to stimuli or events in the presence of other people. The effects of other people on a person's behaviour have not been lost on psychologists; indeed, the recognition of this influence can be found in the very early years of psychology. An American psychologist, Norman Triplett (1861–1931), conducted one of the first formal experiments in this area, observing that cyclists ride faster in the presence of other people than when riding alone. Triplett published the first social psychology research in 1898, and a few social psychology textbooks appeared in 1908.

Despite the early interest in this field, studies of how people influence the behaviour of others did not take off until the 1940s. The events in Nazi-controlled Germany that led up to World War II contributed to the development of this new perspective in psychology. Images from the Holocaust highlighted the need to learn about the role that social factors play in human behaviour. Researchers (and the general public) wanted to understand how normal individuals could be transformed into brutal prison camp guards, how political propaganda affected people, and how society might address issues of stereotyping and prejudice (see Module 13.1). This research evolved into what is now known as **social psychology**, *the study of the influence of other people on our behaviour*.

However, psychologists also noted that not *all* people responded to social groups or the presence of others in the same way. While some people were transformed into prison camp guards in World War II, others objected and joined resistance movements. These individual differences were observable in normal, everyday life as well: Some people are talkative and outgoing while others are quiet. These observations led to the development of **personality psychology**, *the study of how different personality characteristics can influence how we think and act*.

Social psychologists are often motivated to study human behaviours observed in real-world events. In many cases, they hope to reduce the likelihood of an event happening again.

akg-images/Newscom

Although it's easy to think of social psychology (the effect of external factors) and personality psychology (the effect of internal traits) as being distinct, in reality, your personality and the social situations you are in interact. This relationship was most eloquently described by Kurt Lewin (1890–1947), the founder of modern social psychology. Lewin suggested that behaviour is a function of the individual and the environment, or, if you're a fan of formulas (and who isn't?), B = f{I,E}. What Lewin meant was that all behaviours could be predicted and explained through understanding how an individual with a specific set of traits would respond in a context that involved a specific set of conditions. Take two individuals as an example: One tends to be quiet and engages in solitary activities such as reading, whereas the other is talkative and enjoys being where the action is. Now put them in a social situation, such as a large party at a university dorm or a small get-together at a friend's house. How will the two behave? Given the disparity between the individuals and between the two environments, we would suspect that very different behaviours would emerge from these two individuals in the different settings. The outgoing person may have a wonderful time at the big party, while the quiet person desperately tries to find someone to talk to or pretends to be fascinated by something on their phone. But, at the smaller get-together, the quieter person will likely be much more relaxed, while the outgoing person might be bored. Neither behaviour is *better*, but they are *different*. These outcomes illustrate the essence of Lewin's formulation of social psychology.

The Cognitive Revolution

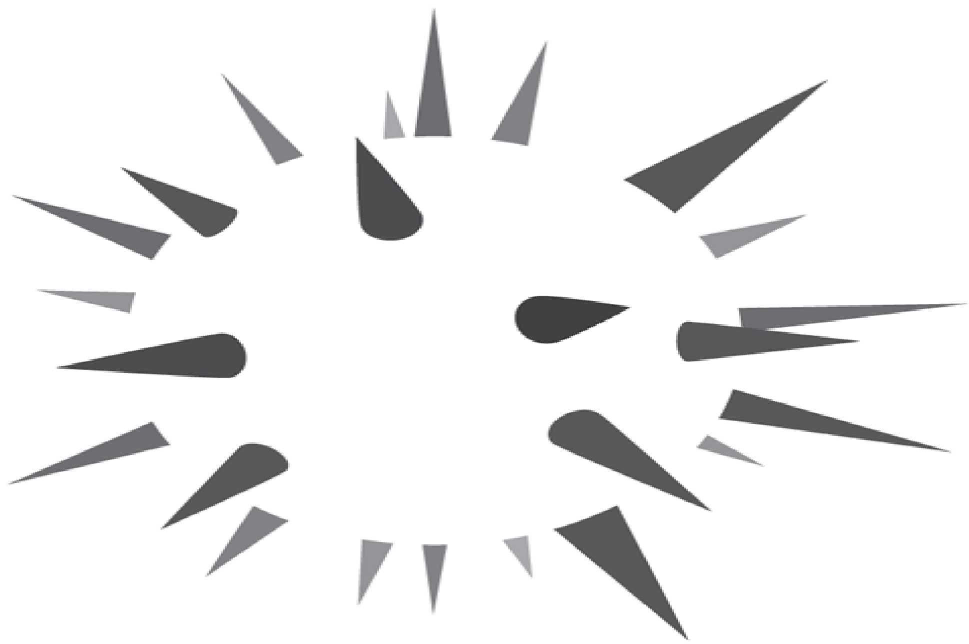
Listen to the Audio

Although behaviourism dominated psychology in the United States and Canada throughout the first half of the 20th century, the view that observable behaviours were more important than thoughts and mental imagery was not universal. In Europe, psychologists retained an emphasis on thinking, and ignored the North Americans' cries to study only what could be directly observed. The European focus on thought flourished through the early 1900s, long before psychologists in North America began to take seriously the idea that they could study mental processes, even if they could not directly see them. Thus, it was the work of European psychologists that formed the basis of the cognitive perspective. Early evidence of an emerging cognitive perspective concerned the study of memory. The German psychologist Hermann Ebbinghaus (1850–1909) collected reams of data on remembering and forgetting (see Module 7.2). British psychologist Frederick Bartlett (1886–1969) found that our memory was not like a photograph. Instead, our cultural knowledge and previous experiences shape what elements of an event or storyline are judged to be important enough to remember.

Another precursor to cognitive psychology can be seen in the early to mid-1900s movement of **Gestalt psychology**, *an approach emphasizing that psychologists need to focus on the whole of perception and experience, rather than its parts* (see Module 4.1). (*Gestalt* is a German word that refers to the complete form of an object; see Figure 1.8.) This contrasts with the structuralist goal of breaking experience into its individual parts.

For example, if Wundt or Titchener were to hand you an apple, you would not think, “Round, red, has a stem . . .”; you would simply think to yourself, “This is an apple.” Gestalt psychologists argued that much of our thinking and experience occur at a higher, more organized level than Wundt emphasized; they believed that Wundt’s approach to understanding experience made about as much sense as understanding water only by studying its hydrogen and oxygen atoms.

Figure 1.8 The Whole Is Greater Than the Sum of Its Parts



The Gestalt psychologists emphasized humans’ ability to see whole forms. For example, you probably perceive a sphere in the centre of this figure, even though it does not exist on the page.

The invention of the computer gave psychologists a useful analogy for understanding and talking about the mind (the *software* of the brain). Linguists such as Noam Chomsky argued that grammar and vocabulary were far too complex to be explained in behaviourist terms; the alternative was to propose abstract mental processes. There was a great deal of interest in memory and perception as well, but it was not until

1968 that these areas of research were given the name “cognitive psychology” by Ulrich Neisser (1928–2012). **Cognitive psychology** *is a modern psychological perspective that focuses on processes such as memory, thinking, and language*. Thus, much of what cognitive psychologists study consists of mental processes that are inferred through rigorous experimentation.

Humanistic Psychology Emerges

Listen to the Audio

Psychology, by the mid-20th century, was dominated by two perspectives, behaviourism and Freudian psychoanalytic approaches, which had almost entirely removed free will from the understanding of human behaviour. To the behaviourists, human experience was the product of a lifetime of rewards, punishments, and learned associations. To the psychoanalysts, human experience was the result of unconscious forces at work deep in the human psyche. From both perspectives, the individual person was merely a product of forces that operated *on* them, and they had little if any control over their own destiny or, indeed, even their own choices, beliefs, and feelings.

In contrast to these disempowering perspectives, a new movement of psychologists arose that emphasized personal responsibility; free will; and the universal longing for growth, meaning, and connection; and that highlighted the power that individuals possessed to shape their own consciousness and choose their own path through life. This new perspective, **humanistic psychology**, *focuses on the unique aspects of each individual human, each person's freedom to act, his or her rational thought, and the belief that humans are fundamentally different from other animals*. Among the many major figures of humanistic psychology were Carl Rogers (1902–1987) and Abraham Maslow (1908–1970). Both psychologists focused on the positive aspects of humanity and the factors that lead to a productive and fulfilling life. Humanistic psychologists sought to understand the *meaning* of personal experience. They believed that

people could attain mental well-being and satisfaction through gaining a greater understanding of themselves, rather than by being diagnosed with a disorder or having their problems labelled. Both Rogers and Maslow believed that humans strive to develop a sense of self and are motivated to personally grow and fulfill their potential (see Module 12.3). This view stands in particular contrast to the psychoanalytic tradition that originated in a medical model and, therefore, focused on illnesses of the body and brain. The humanistic perspective also contrasted with behaviourism in proposing that humans had the freedom to act and a rational mind to guide the process.

The Brain and Behaviour

Listen to the Audio

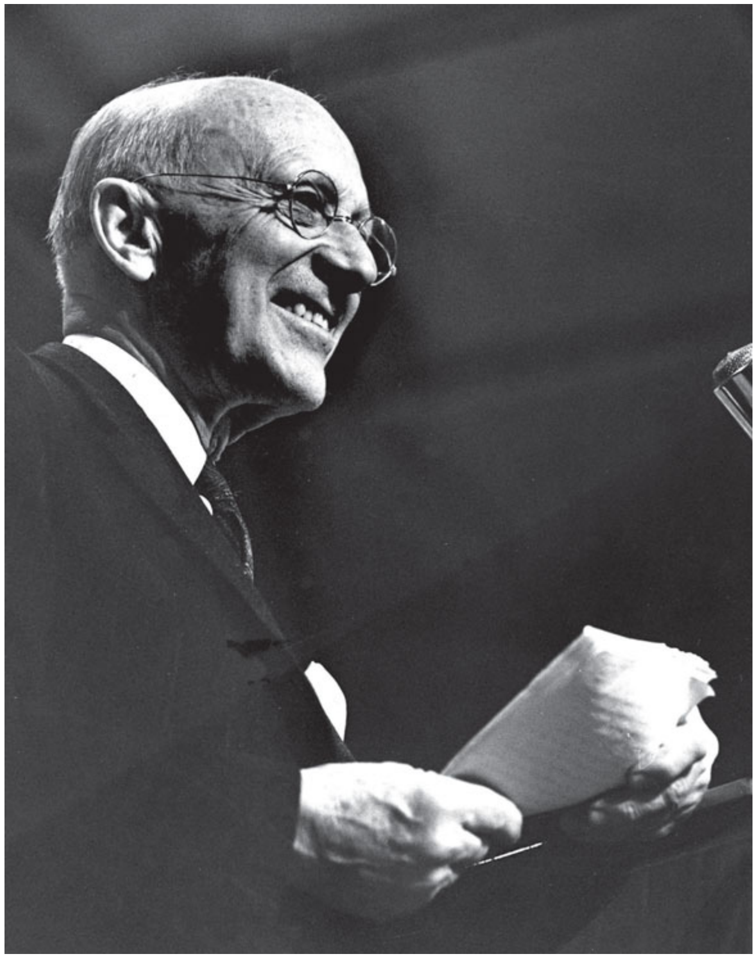
The behaviourists and humanists were not the only researchers attempting to understand human abilities. Many neurologists, surgeons, and brain scientists were also focused on these questions. Notable among them was Donald Hebb (1904–1985), a Canadian neuroscientist working at the Montreal Neurological Institute. Hebb conducted numerous studies examining how cells in the brain change over the course of learning. He observed that when a brain cell consistently stimulates another cell, metabolic and physical changes occur to strengthen this relationship. In other words, cells that fire together wire together (Hebb, 1949; see Module 7.1). This theory, now known as *Hebb's Law*, demonstrated that memory—a behaviour that we can measure and that affects so many parts of our lives—is actually related to activity occurring at the cellular level (Brown & Milner, 2003; Cooper, 2005). It also reinforced the notion that behaviour can be studied at a number of levels ranging from neurons (brain cells) to the entire brain. (Later research, discussed in Module 7.3, has noted that memory is related to social factors as well.)

Donald Hebb made significant contributions to our understanding of memory and the brain.

Montreal Gazette/The Canadian Press

Further evidence for the relationship between the brain and everyday behaviours came from the stimulating work of Wilder Penfield (1891–1976), founder and original director of the Montreal Neurological Institute. Along with his colleague, Herbert Jasper, Penfield developed a surgical procedure to help patients with epilepsy. This procedure involved removing cells from the brain regions where the seizures began;

doing so would prevent the seizures from spreading to other areas of the brain. However, before operating, Penfield needed to find a way to map out the functions of the surrounding brain regions so that he could try to avoid damaging areas that performed important functions such as language. To do this, Penfield electrically stimulated specific areas of each patient's brain while the patient was under local anesthetic (i.e., was awake and therefore conscious). The patient was then able to report the sensations they experienced after each burst of electricity. Based on several patients' reports, Penfield was able to create precise maps of the sensory and motor (movement) cortices in the brain (Penfield & Jasper, 1951; Todman, 2008). Importantly, his work also showed that people's subjective experiences can be represented in the brain (see Module 3.3). This insight suggested that the simple learning model put forth by the behaviourists was not a complete representation of our complex mental world.



Wilder Penfield, founder of the world-famous Montreal Neurological Institute, used electrical stimulation of the brain to discover how movement and touch were represented in the brain. Like Donald Hebb′s, many of his discoveries are still taught in psychology and neuroscience classes throughout the world.

Montreal Gazette/The Canadian Press

Emerging Themes in Psychology

Listen to the Audio

The history of psychology is not over, of course. All of the fields discussed in the previous section of this module continue today. Indeed, psychology is expanding, examining new topics and using new research tools to provide interesting insights into human behaviour. In this section, we highlight five trends or topics that are becoming particularly prominent in psychology. This *is not* an exhaustive list of “hot topics.” Instead, it is a list of important themes that are currently influencing the course of modern psychology.

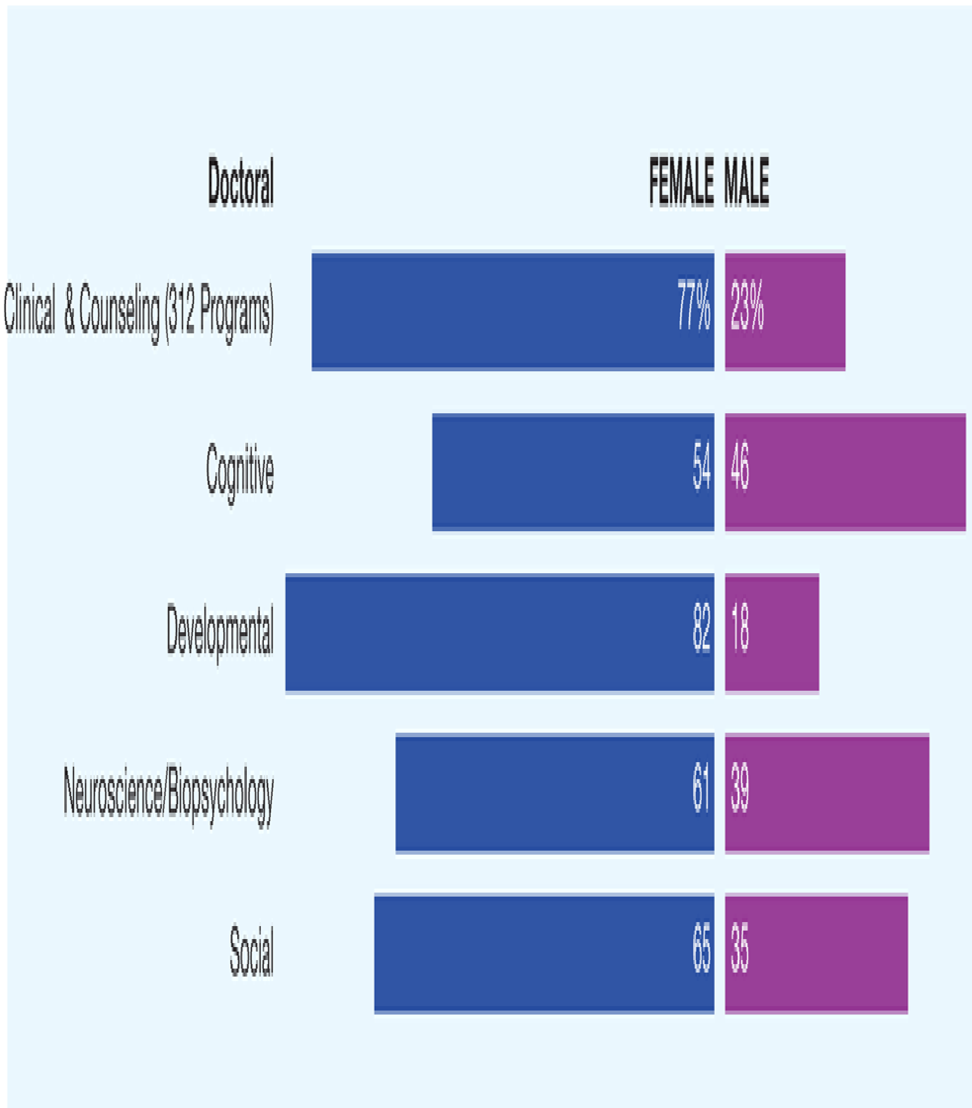
Psychology of Women

Listen to the Audio

After reading earlier sections of this module, many readers might assume that psychology is the exclusive domain of older white men, many sporting impressive beards. In fact, this module *does* have photographs of nine prominent male psychologists (five with beards). However, there *were* female psychologists teaching and performing research during the early stages of the history of psychology. Indeed, Anna Freud (1895–1982) and Karen Horney (1885–1952) made groundbreaking contributions to our understanding of personality. The 1960s saw a dramatic shift in both the role of women in society and in the study of the psychology of women. Until then, many people believed that the male domination of society was due to innate differences between the sexes that made men better leaders; women were thought to be more agreeable and emotional. However, pioneering research from psychologists such as Sandra Bem began to change these views. Researchers began examining how sex differences in power were due in large part to the rampant sexism in politics, the business world, academia, and the home (Bem & Bem, 1973). They also examined how stereotypes could affect women's beliefs about their own abilities (Bem, 1981, 1993). This research led to changes that helped promote more opportunities for women, and this has been especially true in psychology. In North American universities, women outnumber men in psychology graduate programs in every subfield—more than three to one in clinical and counselling psychology graduate programs (Figure 1.9; Fowler et al., 2018). Nonetheless, there remain challenges that affect the sexes differently. Therefore, this

important work continues today, with new generations of female *and male* psychologists working to promote equality.

Figure 1.9 Gender Percentages in Doctoral Psychology Programs



Female doctoral students in psychology now outnumber males in every major field. This shift is in contrast to scientific psychology's first few decades when many universities would not even admit or award degrees to women.

American Psychological Association

Studies of the psychology of women also examine important issues such as women's health, violence toward women, and experiences that are unique to females (e.g., pregnancy). However, this field is not meant to appear "man hating" or exclusive. In fact, many researchers are interested in differences between the sexes and how they influence social behaviour. For instance, in Module 14.2, you will read about the research of Shelly Taylor, who examined sex differences in response to stress. She found that while males *in general* produce a "fight or flight" response to stress, females are more likely to seek out social supports, a tendency she called the "tend and befriend" response (Taylor et al., 2000). Although a complete description of the psychology of women requires its own course, the purpose of this section is to highlight this topic for readers so that they will see how important these types of questions can be for understanding human behaviour, and so that they can better appreciate the obstacles that many of these early researchers faced.

Comparing Cultures

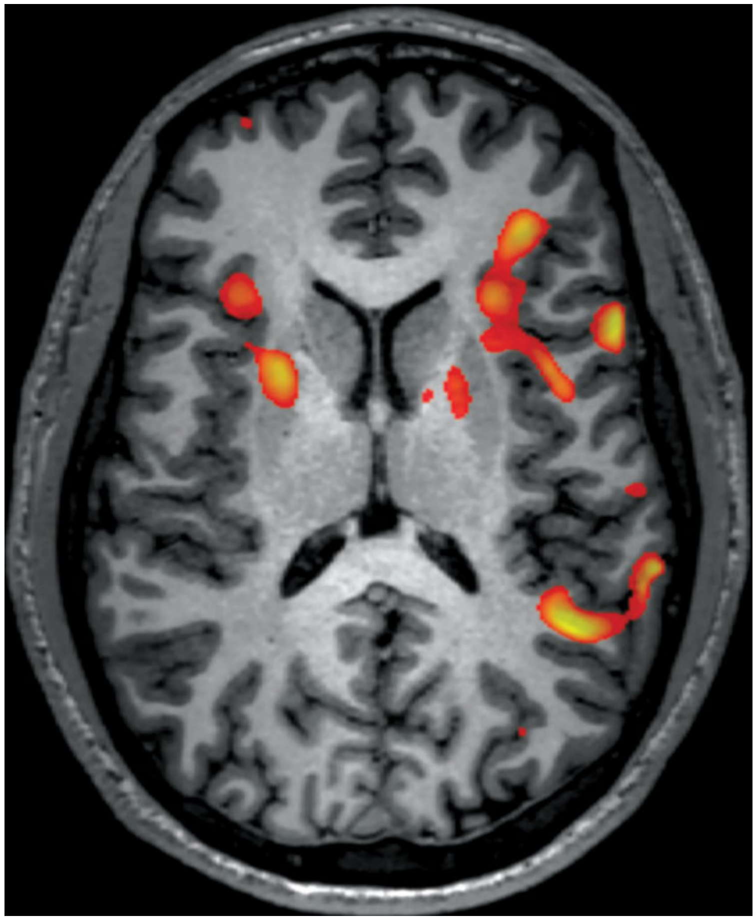
Listen to the Audio

In addition to studying differences between the sexes, researchers have performed numerous studies examining how human behaviour differs across cultures. *Cross-cultural psychology* is the field that draws comparisons about individual and group behaviour among cultures; it helps us understand the role of society in shaping behaviour, beliefs, and values. Many cross-cultural studies compare the responses of North American research participants (generally psychology students like you) to those of individuals in non-Western countries such as China or Japan. However, Western countries with high immigration rates like Canada and the United States also provide researchers with the opportunity to compare the responses and experiences of first- and second-generation Canadians (Abouguendia & Noels, 2001; Gaudet et al., 2005). This type of research therefore allows us to examine how people respond when being pulled in different directions by family history and the culture of their current country of residence. Such comparisons are also being performed using brain imaging, demonstrating that our social and cultural experiences can also be embedded in our brain tissue (Losin et al., 2010).

The Neuroimaging Explosion

Listen to the Audio

Although it has been possible to detect brain activity using sensors attached to the scalp since the late 1920s, the use of brain imaging to study behaviour became much more common in the early 1990s. It was at this time that a technique known as *functional magnetic resonance imaging (fMRI)* was developed. fMRI allows us to reliably detect activity throughout the entire brain and to depict this activity on clear three-dimensional images (see Module 3.4). Initially, fMRI was used to examine relatively straightforward behaviours such as visual perception. However, it quickly became the "go to" tool for researchers interested in understanding the neural mechanisms for cognitive behaviours such as memory, emotion, and decision making. This field, which combines elements of cognitive psychology and biopsychology is known as *cognitive neuroscience*.



fMRIs allow us to reliably detect activity throughout the entire brain and to depict this activity in clear three-dimensional images.

Living Art Enterprises/Photo Researchers, Inc./Science Source

As fMRI became accessible, researchers in other fields of psychology began to incorporate it into their studies. Psychologists studying social behaviours ranging from racism to relationships use fMRI in their experiments; this new field is known as *social neuroscience*. Neuroimaging has also been used to study personality traits and consumer behaviour. In fact, it is difficult to find an area not touched by the development of neuroimaging technologies.

The Search for the Positive

Listen to the Audio

Another rapidly growing area of psychology involves promoting human strengths and potentials. Rather than focusing on pathologies or negative events such as rejection, the goal of *positive psychology* is to help people see the good in their lives by promoting self-acceptance and improving social relationships with others. The eventual goal of this field is to help people experience feelings of happiness and fulfillment; in short, to help them flourish (Seligman & Csikszentmihalyi, 2000).

Positivity has been linked with improvements in some cognitive abilities (Fredrickson, 2003) and to changes in neural pathways associated with controlling your attention (Tang et al., 2010). In fact, researchers are only beginning to understand the potential benefits of positive thinking. Elements of positive psychology can be found in a number of areas of psychological study, ranging from our motivation to achieve (Module 11.3) to techniques for coping with stress and psychological disorders (Modules 14.3 and 16.2).

Psychology in the Real World

Listen to the Audio

Finally, it is important to remember that psychology research isn't limited to the laboratory. Although many researchers are interested in the basic mechanisms of human behaviour, many others apply psychological science in different settings. *Applied psychology* can take place in schools, in the workplace, in the military, or in a number of other settings. For example, researchers at Memorial University in Newfoundland are performing research that will lead to improvements in how children are interviewed in the legal arena (Eastwood et al., 2016; Snook et al., 2014); researchers at the University of Alberta, University of Victoria, Queen's University, and Simon Fraser University examine other areas of psychology in the law, ranging from psychopathy to eyewitness testimony (Douglas et al., 2009; Lindsay et al., 2008). Psychologists across the country have come together to help develop anti-bullying policy and educational initiatives (www.prevnet.ca). *Industrial/organizational psychologists* at the University of Guelph, University of Waterloo, and St. Mary's University, among others, apply psychological research to the workplace, helping to ensure that the work environment is fair for all employees. *Human factors psychologists* help to ensure that our interactions with technologies ranging from computer programs to airplane cockpits are intuitive and efficient. And psychologists are also involved in the promotion of environmentally sustainable behaviours, searching for factors that influence attitudes toward the environment, and for ways to transform our society into one that works *with* nature, rather than against it (Hirsh & Dolderman, 2007; Nisbet & Gick, 2008). In short,

psychological science affects every aspect of our society, even if we don’t realize or appreciate it.

Psychologists work in a number of applied settings. For example, researchers from a number of provinces are involved in important anti-bullying research. These studies are used to influence policies of provincial agencies and local school boards.

SDI Productions/E+/Getty Images

#Psych

Psychology in the Digital World

Most readers are likely to be “digital natives,” people born in the 1990s or later who have never known a world without the internet and mobile phones. It is difficult to overstate the impact that the internet has had on how we follow current events, entertain ourselves, and socialize. In many ways, having immediate access to information has improved quality of life; however, recent current events show us that biased or even completely inaccurate stories on the web can have negative effects that are every bit as powerful as the positive ones. Misinformation has influenced political beliefs and health decisions to such a degree that national elections have been swayed and once-banished diseases have made a comeback in some parts of the world. This power of the internet to shape individuals’ beliefs and behaviour has led some psychologists to study the wired world with the same scientific rigour as the so-called real world.

In order to get readers thinking critically about their electronic activity, we have added a new feature to the Canadian edition of this text: #Psych. In each chapter, we hope to show readers that the concepts you learn about in class also apply to your digital life. As an example, think about the type of information you encounter on your Instagram feed or on social-forum websites such as reddit.com. A recent study from Stanford University reported that 82% of American junior high school students could not distinguish between a real news story and *sponsored content*—often highly biased information written by individuals or organizations who pay to have their opinions interspersed among more factual information (Wineburg et al., 2016). These students tended to view more detailed stories and news items with larger photos as being more believable, regardless of the topic. In other words, they focused on

superficial characteristics of the stimuli rather than using their critical-thinking skills to identify the highly questionable information presented in sponsored content. Our hope is that the #Psych feature boxes will make you a more critical consumer of the information you encounter as you navigate through your own digital world.

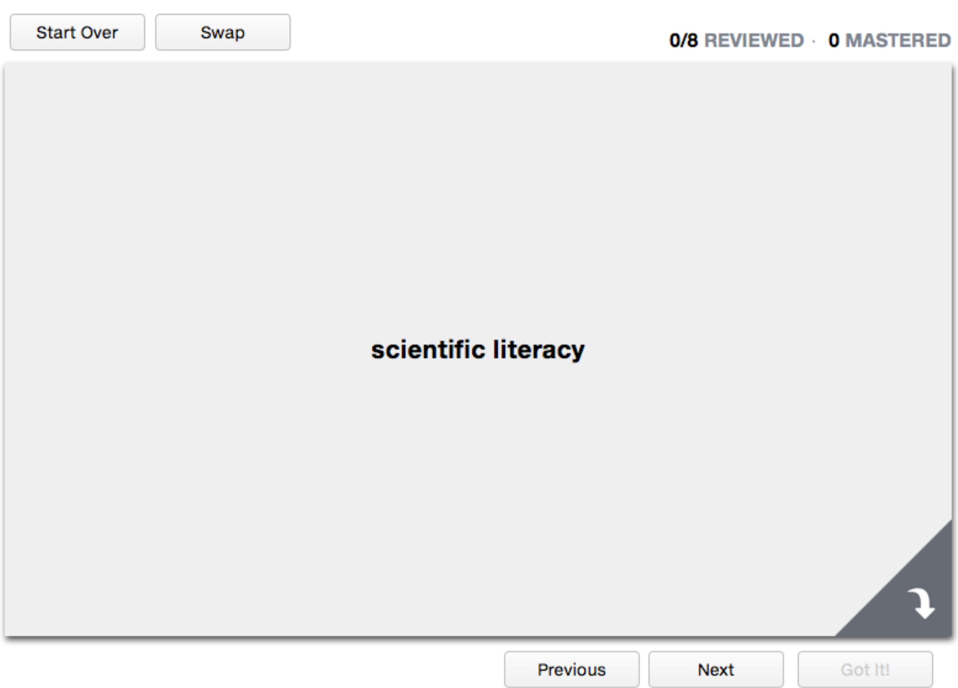
In conclusion, the trends that emerged during the formative years of psychology laid the foundation for the modern perspectives and theories we see today. Psychology is now a clearly established discipline—there are established venues such as professional organizations and journals to disseminate the results of psychological research. Although modern technology, such as brain imaging and computing, would astound psychology's founders, it is likely that they would find the results of modern research absolutely relevant to their own interests. It is also likely that they would be enthusiastic about the increasing levels of collaboration among the various areas of psychology, and about the current zeitgeist of treating human behaviour as a complex system with biological, psychological, and sociocultural components.

Module 1.2 Summary

Listen to the Audio

1.2a Know . . . the key terminology of psychology's history.

Review Module 1.2



1.2b Understand . . . how various philosophical and scientific fields became major influences on psychology.

The philosophical schools of determinism, empiricism, and materialism provided a background for a scientific study of human behaviour. The

first psychologists were trained as physicists and physiologists. Fechner, for example, developed psychophysics, whereas Titchener looked for the elements of thought. Darwin's theory of natural selection influenced psychologist William James's idea of functionalism—the search for how behaviours may aid the survival and reproduction of the organism.

1.2c Apply . . . your knowledge to distinguish among the different specializations in psychology.

Apply Activity

Apply your knowledge to distinguish among different specializations in psychology. You should be able to read a description of a psychologist on the left of Table 1.1 and match their work to a specialization on the right.

Table 1.1 Areas of Specialization within Psychology

1. I am an academic psychologist who studies various methods for improving study habits. I hope to help people increase memory performance and become better students. I am a(n) ______ .

2. My work focuses on how the presence of other people influences an individual's acceptance of and willingness to express various stereotypes. I am a(n) ______ .

3. I have been studying how childrearing practices in Guatemala, Canada, and Cambodia all share some common elements, as well as how they differ. I am a(n) ______ .

4. I am interested in behaviours that are genetically influenced to help animals adapt to their changing environments. I am a(n) ______ .

5. I help individuals identify problem areas of their lives and ways to correct them, and guide them to live up to their full potential. I am a(n) ______ .

WORD BANK

- social psychologist
- evolutionary psychologist
- cross-cultural psychologist
- cognitive psychologist
- humanistic psychologist

Start Over | Check Answers

1.2d Analyze . . . how the philosophical ideas of empiricism and determinism are applied to human behaviour.

Psychology is based on empiricism, the belief that all knowledge—including knowledge about human behaviour—is acquired through the senses. All sciences, including psychology, require a deterministic viewpoint. Determinism is the philosophical tenet that all events in the world, including human actions, have a physical cause. The deterministic view is also essential to the sciences. Applying determinism to human behaviour has been met with resistance by many because it appears to deny a place for free will.

Chapter 2
Reading and Evaluating Scientific Research

2.1 Principles of Scientific Research

- Five Characteristics of Quality Scientific Research
- Working the Scientific Literacy Model: Demand Characteristics and Participant Behaviour
- Five Characteristics of Poor Research
- Module 2.1 Summary

2.2 Scientific Research Designs

- Descriptive Research
- Working the Scientific Literacy Model: Case Studies as a Form of Scientific Research
- Correlational Research
- Experimental Research
- Module 2.2 Summary

2.3 Ethics in Psychological Research

- Promoting the Welfare of Research Participants
- Working the Scientific Literacy Model: Animal Models of Disease
- Ethical Collection, Storage, and Reporting of Data
- Module 2.3 Summary

2.4 A Statistical Primer
Descriptive Statistics
Hypothesis Testing: Evaluating the Outcome of a Study
Working the Scientific Literacy Model: Statistical Significance
Module 2.4 Summary

Module 2.1 Principles of Scientific Research

Listen to the Audio

Hero Images Inc./Alamy Stock Photo

Learning Objectives

2.1a Know . . . the key terminology related to the principles of scientific research.

2.1b Understand . . . the five characteristics of quality scientific research.

2.1c Understand . . . how biases might influence the outcome of a study.

2.1d Apply . . . the concepts of reliability and validity to examples.

2.1e Analyze . . . whether anecdotes, authority figures, and common sense are reliably truthful sources of information.

Can changing your posture make you more confident and powerful while reducing your body's stress responses? In June 2012, a Harvard psychologist made this claim during a TED Talk that became an enormous hit—it has been viewed over 50 million times on the TED channel (TED, 2019) and 16 million more on YouTube (YouTube, 2019). The idea is that we can gain these benefits by assuming a power pose. Imagine the stance of a superhero, standing tall and straight, fists on hips with elbows out, widening the pose. This is the posture of an individual confident in their power. Adopting this type of power pose for a mere two minutes is enough to change the way you think and feel, according to the speaker. Moreover, she linked power posing to increases in hormones contributing to assertiveness while stress hormones were reduced. Before you stand up and assume that position, however, you should know that other researchers have tried the same types of experiments without finding the same results (e.g., Ranehill et al., 2015), particularly regarding the hormonal changes. In another scientific paper, two statisticians argued that the outcome of the

original research resulted from inappropriate data analysis (Simmons & Simonshon, 2017). In fact, enough evidence emerged that the lead author in the original research has since come out against power posing, describing flaws they overlooked in earlier studies (Carney, n.d.). This is not meant to damage the reputation of the original researchers, but instead to emphasize how important it is for psychologists to carefully follow established research methods and procedures—the topic of this chapter.

This chapter might be the most important one in the text. It will give you the training to become a critical consumer of scientific claims that are made by the media, corporations, politicians, and even scientists. Every time you open a news website, you encounter scientific topics such as how certain foods are linked with cancer risks or psychological issues, or you read about wonder drugs that will improve your grades. Some of this research is fantastic, but some is not. The goal of this chapter is to help you separate the good from the questionable, and to show you that asking tough questions about how research was designed and conducted is never a bad thing. Doing so prevents you from being manipulated into buying products and accepting campaign promises that do not hold up to scrutiny. Furthermore, you might find that the most effective ways to build self-confidence take more than two minutes.

What makes science such a powerful technique for examining behaviour? Perhaps the single most important aspect of scientific research is that it strives for objectivity. *Objectivity* assumes that certain facts about the world can be observed and tested independently by the individual who describes them (e.g., the scientist). Everyone—not just the experts—should be able to agree on these facts given the same tools, the same methods, and the same context. Achieving objectivity is not a simple task, however.

As soon as people observe an event, their interpretation of it becomes *subjective*, meaning that their knowledge of the event is shaped by prior beliefs, expectations, experiences, and even their mood. A scientific, objective approach to answering questions differs greatly from a subjective one. Most individuals tend to regard a scientific approach as one that is rigorous and demands proof. In this module, we will discuss the key elements of this scientific approach, and how it can help us understand human behaviour.

Five Characteristics of Quality Scientific Research

Listen to the Audio

During the past few centuries, scientists have developed methods to help bring us to an objective understanding of the world. The drive for objectivity influences how scientific research is conducted in at least five ways. Quality scientific research meets the following criteria:

1. It is based on measurements that are *objective*, *valid*, and *reliable*.
2. It can be *generalized*.
3. It uses techniques that *reduce bias*.
4. It is made *public*.
5. It can be *replicated*.

As you will soon read, these five characteristics of good research overlap in many ways, and they will apply to any of the methods of conducting research that you will read about in this text.

Scientific Measurement: Objectivity

Listen to the Audio

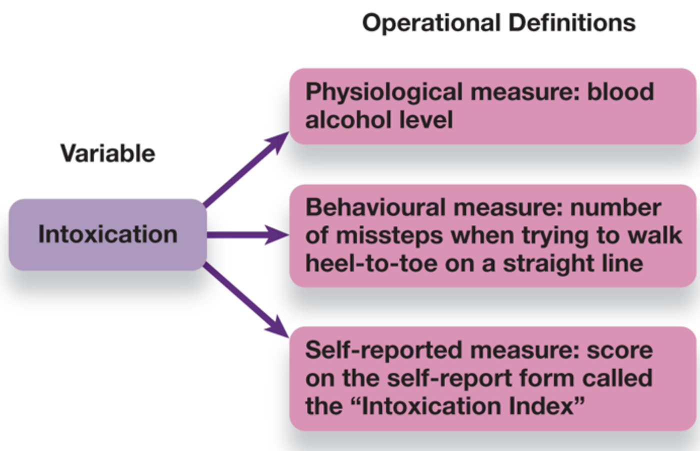
The foundation of scientific methodology is the use of **objective measurements**, *the measure of an entity or behaviour that, within an allowed margin of error, is consistent across instruments and observers*. In other words, the way that a quality or a behaviour is measured must be the same regardless of who is doing the measuring and the exact tool being used. For example, weight is measured in pounds or kilograms. One kilogram in St. John's is the same as one kilogram in Victoria—researchers don't get to choose how much mass a kilogram is worth. Similarly, your weight will be the same regardless of whether you're using the scale in your bathroom or the scale in the change room at the gym. However, your weight *will* vary slightly from scale to scale—this is the margin of error mentioned in the definition. Scientists in a given field have to agree upon how much variability is allowable. Most people will be comfortable if their weight differs by one or two kilograms depending on the scale being used. But, if you weigh 70 kg on one scale and 95 kg on the other, then you know one of your measurement tools is inaccurate.

In this example, weight would be considered a **variable**, *the object, concept, or event being controlled, manipulated, or measured by a scientist*. Variables are an essential part of the research described in every chapter of this text ranging from perceptual processes, to learning and memory, to how we interact with each other, and so on. For most of psychology's history, measurements involved observations of behaviour in different situations or examinations of how participants responded on a

questionnaire or to stimuli presented on a computer. However, as technology advanced, so did the ability to ask psychological questions in new and interesting ways. High-tech equipment, such as functional magnetic resonance imaging (fMRI), allows researchers to view the brain and see which areas are activated while you perform a variety of tasks such as remembering words or viewing emotional pictures. Other physiological measures might involve gathering samples of blood or saliva, which can then be analyzed for enzymes, hormones, and other biological variables that relate to behaviour and mental functioning. With this greater number of measurement options, it's now possible to examine the same variable (e.g., anxiety) using a number of different techniques. Doing so strengthens our ability to understand the different elements of behaviour.

Regardless of the specific experimental question being asked, any method used by a researcher to measure a variable needs to include carefully defined terms. This isn't always as easy as it sounds. How would you define personality, shyness, or cognitive ability? This is the type of question a researcher would want to answer very carefully, not only for planning and conducting a study, but also when sharing the results of that research. In order to do so, researchers must decide upon a precise definition that other researchers can understand. These **operational definitions** *are statements that describe the procedures (or operations) and specific measures that are used to record observations* (Figure 2.1). For example, depression could be operationally defined as "a score of 20 or higher on the Beck Depression Inventory" (Beck & Steer, 1977), with the measure being a common and widely accepted clinical questionnaire.

Figure 2.1 Operational Definitions



A variable, such as the level of intoxication, can be operationally defined in multiple ways. This figure shows operational definitions based on physiology, behaviour, and self-report measures.

Scientific Measurement: Reliability and Validity

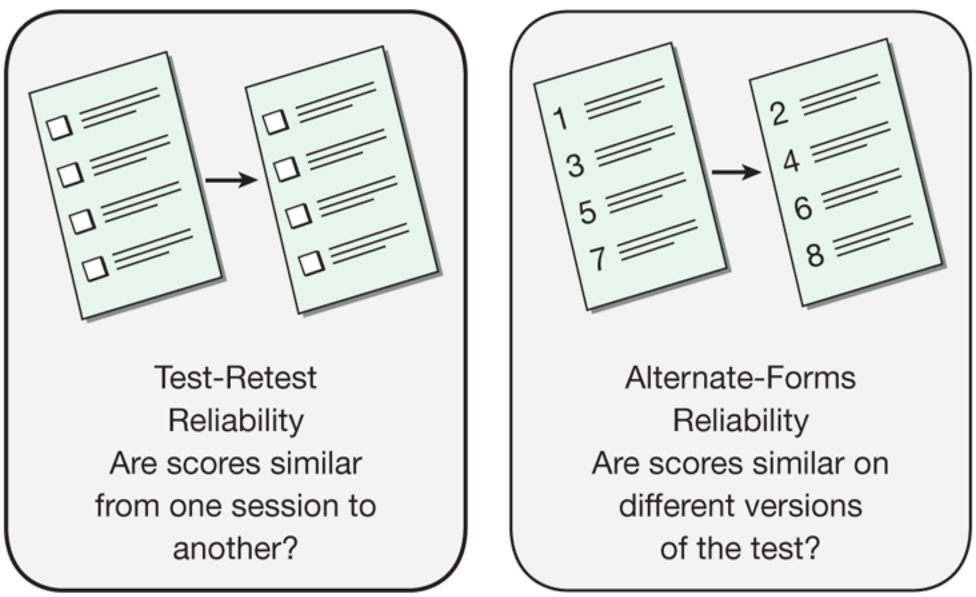
Listen to the Audio

Once researchers have defined their terms, they then turn their attention toward the tools they plan to use to measure their variable(s) of interest. The behavioural measurements that psychologists make must be valid and reliable. **Validity** refers to *the degree to which an instrument or procedure actually measures what it claims to measure*. As is the case with operational definitions, creating a valid measurement may seem like a simple task. In reality, developing valid measures of complex behaviours is quite challenging. To go back to the depression example, researchers cannot simply ask people a few questions and then randomly decide that one score qualifies as depressed while another does not. Instead, for the measure to be valid, a particular score would have to differentiate depressed and non-depressed people in a way that accurately maps onto how these people actually feel (i.e., a depressed person would score differently than a non-depressed person). The creation of valid measures is therefore quite time-consuming and requires a great deal of testing and revising before the final product is ready for use.

In addition to being valid, a measurement tool must also be reliable. A measure demonstrates **reliability** *when it provides consistent and stable answers across multiple observations and points in time*. There are actually a number of different types of reliability that affect psychological research (see Figure 2.2). *Test-retest reliability* examines whether scores on a given measure of behaviour are consistent across test sessions. If your

scores on a test of depression vary widely each time you take the test, then it is unlikely that your test is reliable. *Alternate-forms reliability* is a bit more complicated. This form of reliability examines whether different forms of the same test produce the same results. Why would you need multiple forms of a test? In many situations, a person will be tested on multiple occasions. For instance, individuals with brain damage might have their memory tested soon after they arrive at the hospital and then at one or more points during their rehabilitation. If you give these individuals the exact same test, it is possible that any improvement is simply due to practice. By having multiple versions of a test that produce the same results (e.g., two equally difficult lists of words as stimuli for memory tests), researchers and hospital workers can test individuals on multiple occasions and know that their measurement tools are equivalent.

Figure 2.2 Test-Retest and Alternate-Forms Reliability



Test-retest reliability assumes that if the same test is taken at two or more different times, the scores will be similar. Alternate-forms reliability assumes that if a person completed different versions of the same test (e.g., Version A and Version B), their scores would be similar.

A third type of reliability takes place when observers have to score or rate a behaviour or response. For example, psychologists might be interested in the effects of nonverbal behaviour when people interact, so they might videotape participants solving a problem and then have trained raters count the number of touches or the amount of eye contact that occurred during the experiment. As another example, participants might write down lengthy, open-ended responses to an experimenter's questions; these responses would then be rated on different variables by laboratory personnel. The catch is that more than one person must do the rating; otherwise it is impossible to determine if the responses were accurately measured or if the results were due to the training, expertise, or expectations of the single rater. Having more than one rater allows you to have *inter-rater reliability*, meaning that the raters arrive at very similar conclusions. If you design an experiment with clear operational definitions and criteria for the raters, then it is likely that you will have high inter-rater reliability.

Reliability and validity are essential components of scientific research. In addition, it is usually very important that your results are not limited to a small group of people in a single laboratory. Instead, it is ideal for these results to relate to other groups and situations—in other words, to be generalizable.

Generalizability of Results

Listen to the Audio

Although personal testimony can be persuasive and (sometimes) interesting, psychologists are primarily interested in understanding behaviour *in general*. This involves examining trends and patterns that will allow us to predict how *most people* will respond to different stimuli and situations. **Generalizability** *refers to the degree to which one set of results can be applied to other situations, individuals, or events*. For example, imagine that one person you know claimed that a memory-improvement course helped them raise their grades. How useful is the course? Based on this information, you might initially view the course favourably. However, upon further reflection, you'd realize that a number of other factors could have influenced your friend's improvement, not the least of which is that they are suddenly paying more attention to their grades! At this point, you would wisely decide to wait until you've heard more about the course before investing your hard-earned money. But, if you found out that several hundred people in your city had taken the same course and had experienced similar benefits, then these results will appear more likely to predict what would happen if you or other people took the course. They are generalizable.

As you can see from this example, one way to increase the possibility that research results will generalize is to study a large group of participants. By examining and reporting an average effect for that group, psychologists can get a much better sense of how individuals are *likely* to behave. But how large of a group is it possible to study? Ideally, it would

be best to study an entire **population**, *the group that researchers want to generalize about*. In reality, the task of finding all population members, persuading them to participate, and measuring their behaviour is impossible in most cases. Instead, psychologists typically study a **sample**, *a select group of population members*. Once the sample has been studied, then the results may be generalized to the population as a whole.

It is important to note that the method used to select a sample greatly influences whether your results are generalizable. If your sample for the memory-improvement course was limited to middle-aged male doctors in Edmonton, it would be difficult to generalize those results to all Canadians. Instead, researchers try to use a **random sample**, *a sampling technique in which every individual of a population has an equal chance of being included*. If you wanted to study the population of students at your school, for example, the best way to obtain a true random sample would be to have a computer generate a list of names from the entire student body. Your random sample—a subset of this population—would then be identified, with each member of the population having an equal chance of being selected regardless of class standing, gender, major, living situation, and other factors. Of course, it isn't always possible to use random sampling. This is particularly true if you are hoping that your results generalize to a large population or to all of humanity. In these cases, researchers often have to settle for **convenience samples**, *samples of individuals who are the most readily available*—for example, Introductory Psychology students.

In a random sample, all members of a population (e.g., Winnipeggers) would be equally likely to be selected to be part of a study. This type of sampling is not always possible. Instead, many psychologists test their hypotheses using a convenience sample, such as psychology students.

Ariel Skelley/Digital Vision//Getty Images

In addition to generalizing across individuals, psychological research should generalize across time and location. Research should ideally have high **ecological validity**, *meaning that the results of a laboratory study can be applied to or repeated in the natural environment*. Sometimes this connection doesn't seem obvious, such as computer-based studies testing your ability to pay attention to different stimuli on a computer screen, but such seemingly artificial situations are assessing human abilities that are used in very common situations such as driving or finding a friend in a crowded classroom.

Although generalizability and ecological validity are important qualities of good research, we need to be careful not to *over-generalize*. For example, results from a convenience sample of university students might not predict how a group of elderly people would do on the same task; it's

simply not possible to know for sure until someone conducts research on a sample from the older population.

Sources of Bias in Psychological Research

Listen to the Audio

Of course, generalizability is only important if the experiment itself was conducted without bias. While creating objective, reliable, and valid measures is important in quality research, various types of bias can be unintentionally introduced by the researchers; this is known as a *researcher bias*. For instance, the experimenter may treat participants in different experimental conditions differently, thus making it impossible to know if any differences were due to the experimental manipulation being tested or were instead due to the experimenter's behaviour. It is also possible for the participants, including animals, to introduce their own bias; these effects are known as *subject biases* or *participant biases*. Sometimes this bias will involve a participant trying to figure out what the experimenters are testing or trying to predict the responses that the researchers are hoping to find.

Bias can also be introduced by the act of observation itself. A wonderful example of this tendency was provided by workers at the Western Electric Company's Hawthorne Works, a Chicago-area factory in the 1920s. Researchers went to the factory to study the relationship between productivity and working conditions. When the researchers introduced some minor change in working conditions, such as an adjustment to the lighting, the workers were more productive for a period of time. When they changed another variable in a different study—such as having fewer but longer breaks—productivity increased again. What was not obvious to the researchers was that *any* change in factory conditions brought about

increased productivity, presumably because the changes were always followed by close attention by the factory supervisors (Adair, 1984; Parsons, 1974). The results were due to the participants noticing that they were being observed rather than to the variables being manipulated. In honour of these observations, a *behaviour change that occurs as a result of being observed* is now known as the **Hawthorne effect**.

The Hawthorne Effect, named after the Western Electric Company's Hawthorne Works in Chicago, occurs when individuals change their behaviour because they are being observed.

In most psychological research, the participants are aware that they are being observed. This presents a different form of problem, however. *Participants may respond in ways that increase the chances that they will be viewed favourably by the experimenter and/or other participants*, a tendency known as **social desirability (or socially desirable responding)**. This type of bias is particularly relevant when the study involves an interview in which the researcher has face-to-face contact with the volunteers. As a result, many researchers now collect data using computers; this allows the participants to respond with relative anonymity, thereby reducing the desire to appear likeable.

In these situations, the participants can look for feedback—intentional or unintentional—and then adapt their responses to be consistent with what they think is expected of them. The potential biasing effects of social desirability show us a challenge faced by many psychologists: the need to limit the effect that they have on the results of their own study so that the results are due to the variables being studied rather than to the participants responding to cues from the researcher. As you will read in the next section, this challenge is not as simple as it appears.

In a related issue, participant anxiety about the experiment—which often leads to changes in how people respond to questions—can be reduced if researchers provide full information about how they will eventually use the data. Many people assume that psychologists are "analyzing them"; in fact, if you mention at your next family gathering that you're taking a psychology course, it is almost certain that someone will make a joke about this. If volunteers know that the data will *not* be used to diagnose psychiatric problems, affect their grades, or harm them in some other way, then their concerns about the study will be less likely to affect their performance.

Psych@

The Hospital: The Placebo Effect

The fact that demand characteristics can alter results is of particular importance for researchers investigating new treatments for different psychological or medical conditions. Patients enter treatment programs (and experiments) with a number of expectations, and these expectations can lead to a **placebo effect**, *a measurable and experienced improvement in health or behaviour that cannot be attributable to a medication or treatment*. When researchers test the effectiveness of a new drug, it is standard procedure for one group of volunteers to be treated with the drug while a second group is given an inactive substance (the *placebo*). Regardless of the group, no volunteers are told whether they have received the drug or the placebo. What sometimes happens is that people in the placebo group report as much improvement as the people who actually received the drug. This does not mean the placebo magically turned into a drug, only that a volunteer's expectations about the drug affected their brain and body. This effect is not limited to medications—it can be found with other medical treatments as well.

Why do people receiving a placebo claim to feel better? The initial explanation was that the patients' expectations caused them to simply convince themselves they feel better (i.e., it was "all in their head"). Other research noted that many people who are given a placebo show physiological evidence of relief from pain and nausea (Hrobjartsson & Gotzsche, 2010). Recent research suggests that both of these explanations have merit (Geuter, Koban, & Wager, 2017). In brain imaging studies people

responding to placebos showed increased activity in several regions of the frontal lobes—areas that are involved in understanding the current context, establishing expectations, and detecting changes. These results suggest that there are multiple ways for placebos to affect our responses to pain. Placebos are an important part of experimental research in psychology and related fields, so it is important to recognize their potential influence on how research participants respond.

Working the Scientific Literacy Model

Demand Characteristics and Participant Behaviour

Listen to the Audio

Results of psychological studies *should* provide uncontaminated views of behaviour. In reality, however, people who participate in psychological studies typically enter the research environment with a curiosity about the subject of the study. Researchers need to withhold as much detail as possible (while still being ethical) to get the best, least biased results possible.

What do we know about how bias affects research participants?

When studying human behaviour, a major concern is **demand characteristics**, *inadvertent cues given off by the experimenter or the experimental context that provide information about how participants are expected to behave*. Early psychologists often thought of the people being tested as *subjects*. This term, still commonly used, assumes that individuals taking part in an experiment will follow instructions (within reason) and will not put too much thought into why certain stimuli are being presented or certain experimental manipulations are occurring. This view changed in the 1950s and 1960s when psychologists began applying the scientific method to more cognitive topics. Researchers quickly realized that people are active participants in psychological experiments (Orne, 1962). These participants examine their

environment and attempt to understand *why* certain stimuli and procedures are being used. As part of this attempt to "figure out" the study, participants will look to the behaviour of other people in that setting, including the experimenters. Sometimes, the actions, tone of voice, body language, or facial expressions of the experimenter can bias participants' responses. These demand characteristics can range from very subtle to obvious influences on the behaviour of research participants (Orne, 1962).

How can science test the effects of demand characteristics on behaviour?

Some classic examples of how demand characteristics can influence results come from the research of Rosenthal and colleagues. In one study, researchers told teachers in 18 different classrooms that a group of children had an "unusual" potential for learning, when in reality they were just a random selection of students (Rosenthal & Jacobson, 1966). After eight months of schooling, the children singled out as especially promising showed significant gains not just in grades, but in intelligence test scores, which are believed to be relatively stable. Why would this occur if the students were randomly selected? The best explanation is that the observers (i.e., teachers) assumed those students would do well, and were therefore more likely to pay attention to those students and to give them positive and encouraging feedback. These positive experiences with the teachers likely motivated these students to improve themselves. In other words, the students changed their behaviour patterns in order to match up with the expectations of the teachers. It is easy to see how similar experimenter effects could occur in psychological research studies.

Experimenter bias can even be found when people work with animals. When research assistants were told they were handling

“bright” rats, it appeared that the animals learned significantly faster than when the assistants were told they were handling “dull” rats. Because it is unlikely that the rats were influenced by demand characteristics—they were not trying to give the researchers what they wanted—the most likely explanation for this difference is that researchers made subtle changes in how they treated the animals, and in how they observed and recorded behaviour (Rosenthal & Fode, 1963).

How can we critically evaluate the issue of bias in research?

This issue of bias in research is very difficult to overcome. Very few researchers intentionally manipulate their participants to get the exact responses they hope for; however, as you have read, many times these influences are subtle and accidental. In most cases, the individuals interacting with research participants are student research assistants. To prevent unintentional bias, these researchers complete rigorous training and follow careful scripts during the actual experiment. These precautions help reduce experimenter effects. Additionally, many studies include interviews or questionnaires at the end of the study asking participants what they thought the experiment was about. This information can then be used by the experimenters to determine if the data from that participant are due to the experimental manipulation or to demand characteristics.

One way to evaluate whether participants’ expectations are influencing the results is to create an additional manipulation in which the researchers give different groups of participants different expectations of the results. For example, researchers could simply tell one group that “this exercise should have a big effect” while telling a second group that “we have no idea if this exercise even works.” Then, if the groups differ during or after

performing the same task, the participants' beliefs about the researchers' expectations might be influencing performance. Of course, it is not always practical to include an additional group in a study, and, when doing clinical research, manipulating expectations might not be ethical. But when researchers begin performing research on new topics or with new research methods, testing for demand characteristics would be a wise decision.

Why is this relevant?

Demand characteristics and other sources of bias all have the potential to compromise research studies. Given the time, energy, and monetary cost of conducting research, it is critical that results are as free from contamination as possible. The science of psychology involves the study of a number of very sensitive topics; the results are often used to help policymakers make better-informed decisions. Producing biased results will therefore have negative effects upon society as a whole. Demand effects are particularly problematic when studying clinical populations or when performing experiments with different types of clinical treatments. The results of these studies affect what we know about different patient populations and how we can help them recover from their different conditions. Biased results could therefore affect the health care of vulnerable members of our society.

Techniques That Reduce Bias

Listen to the Audio

Subject and research biases threaten the validity and reliability of psychological research. Therefore, experimenters have established a number of techniques that can reduce the impact of subject and researcher biases. One of the best techniques for reducing subject bias is to provide anonymity and confidentiality to the volunteers. *Anonymity* means that each individual's responses are recorded without any name or other personal information that could link a particular individual to specific results. *Confidentiality* means that the results will be seen only by the researcher. Ensuring anonymity and confidentiality are important steps toward gathering honest responses from research participants. Participants are much more likely to provide information about sensitive issues like their sexual history, drug use, or emotional state if they can do so confidentially and anonymously.

Placebos are also an important means of reducing bias. The critical element of the placebo effect is that the participants *believe* the pill or liquid they are consuming is actually a drug. If they knew that they were receiving a placebo instead of a pain medication, they would not experience any pain relief. Therefore, it is important that experiments involving drugs (recreational or therapeutic) utilize what are known as *blind* procedures. In a **single-blind study**, *the participants do not know the true purpose of the study, or else do not know which type of treatment they are receiving (e.g., a placebo or a drug)*. In this case, the subjects are "blind" to the purpose of the study. Of course, researchers can introduce bias as

well, especially if they believe a research participant is taking the actual medication instead of a placebo. They might unintentionally interpret that the symptoms are improving, or perhaps treat individuals in the two conditions differently, thus biasing the results. This researcher bias is not necessarily overt or intentional. In order to eliminate this possibility, researchers often use a technique known as a **double-blind study**, *a study in which neither the participant nor the experimenter knows the exact treatment for any individual*. To carry out a double-blind procedure, the researcher must arrange for an assistant to conduct the observations or, at the very least, the researcher must not be told which type of treatment a person is receiving until after the study is completed.

Double-blind procedures are also sometimes used when researchers are testing groups that differ on variables such as personality characteristics or subtle demographic factors such as sexual orientation. If the experimenters know that participants have scored high on a test of psychopathy, they might treat them differently than they treated a person who scored low on the same test. Keeping the experimenter (and participants) blind to these results allows the research to remain objective. Therefore, researchers should use these techniques whenever possible.

Sharing the Results

Listen to the Audio

Once a group of researchers has designed and conducted an objective experiment that is free of bias, it is important to communicate their findings to other scientists. Psychology's primary mode of communication is through academic journals. Academic journals resemble magazines in that they are usually soft-bound periodicals with a number of articles by different authors (online formats are typically available as well). Unlike magazines, however, journal articles represent primary research or reviews of multiple studies on a single topic. When scientists complete a piece of research, they may write a detailed description of the theory, hypotheses, measures, and results and submit the article for possible publication. You will not find journals or research books in your average mall bookstore because they are too technical and specialized for the general market (and are not exactly page-turners), but you will find thousands of them in your university library and online.

However, only a fraction of the manuscripts submitted to journals eventually get published. Rather, before research findings can be published, they must go through **peer review**, *a process in which papers submitted for publication in scholarly journals are read and critiqued by experts in the specific field of study*. In the field of psychology, peer review involves two main tasks. First, an editor receives the manuscript from the researcher and determines whether it is appropriate subject matter for the journal (e.g., an article on 17th-century Italian sculpture would not be appropriate for publication in the *Journal of Behavioral Neuroscience*, which

is focused on biological explanations for behaviour). Second, the editor sends copies of the manuscript to a select group of peer reviewers—*peer* in this case refers to another professional working within the same field of study. These reviewers critique the methods and results of the research and make recommendations to the editor regarding the merits of the research. In this process, the editors and reviewers serve as gatekeepers for the discipline, which helps increase the likelihood that the research is made public.

Replication

Listen to the Audio

Once research findings have been published, it is then possible for other researchers to build upon the knowledge that you have created; it is also possible for researchers to double check whether or not your results simply occurred by chance (which does happen). Science is an ongoing and self-correcting process. The finest, most interesting published research study can quickly become obsolete if it cannot be replicated. **Replication** *is the process of repeating a study and finding a similar outcome each time*. As long as an experiment uses sufficiently objective measurements and techniques, and if the original hypothesis was correct, similar results *should* be achieved by later researchers who perform the same types of studies.

Results are not always replicated in subsequent investigations, however. Psychology, like many other scientific fields, is experiencing what the media call a "replication crisis." In 2015, the influential journal *Science* published a paper describing the efforts of a group of researchers—known as the Open Science Collaboration (OSC)—to replicate 100 studies that had been published in three well-known journals (OSC, 2015). Although the hope was that the vast majority of these studies would replicate, the results showed the opposite. Depending upon the statistical cut-offs used, only 36% to 47% of the studies were successfully replicated. This result was quite upsetting for most psychologists, as it implied that our field has some serious methodological problems. However, before assuming that psychology should be tossed aside, it is worth thinking about this issue in

more detail. Psychology, like all sciences, experiences a *publication bias* in which successful and novel results are published and studies that showed no effects are not. Indeed, this bias is why replication is so important—it helps us determine if these published studies are simply statistical flukes. However, if a single replication attempt is unsuccessful, which result should we believe—the original published experiment or the failed attempt to replicate it? This dilemma was not only pointed out by critics of the original OSC paper (Gilbert et al., 2016), but was noted by some of the OSC researchers themselves. The solution appears to involve performing the same study a number of times and across a number of locations to see if it generally produces similar results. Such a strategy was used by the Many Labs Project (MLP). (It is unclear why these replication teams give themselves catchy "squad names.") These researchers performed the same studies over 30 times and found that 10 of the 13 studies they critiqued were replicable (Klein et al., 2014). Perhaps if these replication efforts were applied to the Power Poses described at the beginning of the chapter, researchers could have identified the shortcomings of their research and developed more recommendations or interventions to build assertiveness. Unfortunately, it would be impossible to replicate every published study. Regardless, these efforts send an important message to both researchers and students: replication is important and makes science better.

Five Characteristics of Poor Research

Listen to the Audio

In the preceding section, you read about the characteristics of quality research. It is generally safe to assume that the opposite characteristics detract from the quality of research. Good research uses valid, objective measures; poor research uses measures that are less valid, less reliable, and, therefore, less likely to be replicable. However, other issues must also be scrutinized if you hear someone make a scientific-sounding claim. Most claims are accompanied by what might sound like evidence, but evidence can come in many forms. How can we differentiate between weak and strong evidence? Poor evidence comes most often in one of five varieties:

1. It produces *untestable hypotheses*.
2. It relies on *anecdotes* and personal experiences.
3. It includes a *biased selection of data*.
4. It makes *appeals to authority* rather than facts.
5. It makes *appeals to common sense*.

Untestable Hypotheses

Listen to the Audio

Perhaps the most important characteristic of science is that its hypotheses are testable. For a hypothesis to be testable, it must be **falsifiable**, meaning that *the hypothesis is precise enough that it could be proven false*. If a hypothesis is not falsifiable, that means that there is no pattern of data that could possibly prove that this view is wrong; instead, there is always a way to reinterpret the results to make the hypothesis match the data. If you cannot disconfirm a hypothesis, there is no point in testing it. This fact is so ingrained in psychologists' training that there are very few examples of unfalsifiable hypotheses in modern psychology. However, that does not mean they come easily; developing a sound, testable hypothesis is at times very much like coming up with a solution to a puzzle. In fact, some particularly challenging ideas have taken months or even years to solve.

Examples of Falsifiability

What is falsifiable?
A claim is falsifiable if there is a potential observation that can disprove it. Many statements that are non-falsifiable would require a search through nearly infinite possibilities to show that it is incorrect. Other non-falsifiable statements may be unclear, or a matter of opinion.

For example:
Chimpanzees do not have the ability to recognize themselves in a mirror.

- Falsifiable: If we observe a single chimpanzee that passes a self-recognition test, then this statement is false.

There is intelligent, human-like life on other planets.

- Not falsifiable: We could never completely scour the Milky Way and thoroughly search every planet.

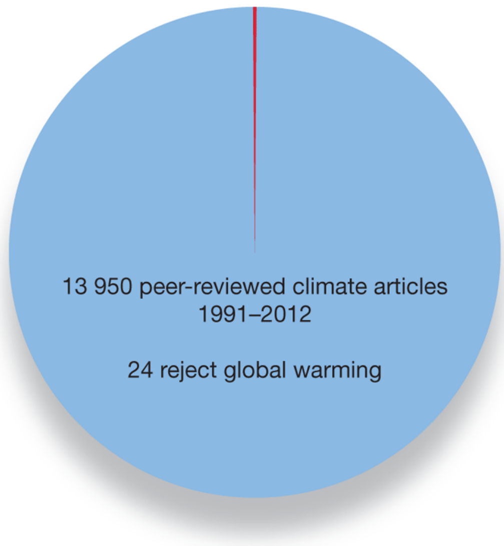
Previous Next

A second characteristic of poor research is the use of **anecdotal evidence**, *an individual's story or testimony about an observation or event that is used to make a claim as evidence*. For example, a personal testimonial on a product's web page might claim that a man used subliminal weight-loss recordings to lose 20 kg in six months. But there is no way of knowing whether the recordings were responsible for the person's weight loss; the outcome could have been due to any number of things, such as a separate physical problem or changes in food intake and lifestyle that had nothing to do with the subliminal messages. In fact, you do not even know if the anecdote itself is true: The "before" and "after" photos could easily have been doctored. Anecdotal evidence is also misused in attempts to argue against sound research. For example, significant research shows a link between corporal punishment during childhood (e.g., parents relying on spanking to discipline children) and subsequent psychological, substance abuse, and legal problems in adulthood. The evidence is so strong that since 2012 the Canadian Medical Association has been advocating that corporal punishment be legally banned (Fletcher, 2012). One person claiming, "My parents spanked me and I

turned out fine" does not invalidate the research; there is still a remarkable trend connecting corporal punishment to these undesirable outcomes even if it does not work out that way for 100% of the population. Therefore, we must be wary of such anecdotal claims. If they are not backed up by a peer-reviewed scientific study, we should view the claims with caution.

However, we still need to be careful even if a scientific claim is backed up by published data. It is possible that some individuals—particularly politicians and corporations—might present only the data that support their views. A beautiful example of this *data selection bias* is shown in the debate over whether human behaviour is a major cause of climate change. A climate-change denier could point out that 24 peer-reviewed scientific studies cast doubt on whether human behaviour is a cause of global warming. Twenty-four sounds like a large body of research. However, James Powell, a member of the U.S. National Science Board, carefully examined all of the climate-change data from 1991 to 2012 and found 13 926 papers supporting this view (see Figure 2.3). Therefore, a very selective slice of the data would present one (biased) result, but a thorough and scientific representation of the data would present an entirely different view of the same issue.

Figure 2.3 Data Selection Bias



People with a particular political or economic agenda can still make claims that appear scientific if they perform a biased selection of the available data. Groups opposed to the idea that human activity is playing a role in global warming often point to published research supporting their view. However, when one examines *all* of the data on global warming, it appears that negative findings make up less than 1% of the results, suggesting that these individuals are full of hot air.

Source: 1991–2012 Pie Chart, retrieved from www.jamespowell.org. Reprinted with permission of James Powell.

The fourth kind of questionable evidence is the **appeal to authority**—*the belief in an "expert's" claim even when no supporting data or scientific evidence is present*. Expertise is not actually evidence; "expert" describes the person making the claim, not the claim itself. It is entirely possible that the expert is mistaken, dishonest, misquoted, or perhaps only an expert in a tangentially related field. True experts are good at developing evidence, so if a claim cites someone's expertise as evidence, then you should see whether the expert offers the corresponding data to support the claim. It is not unusual for people to find that an expert's claim actually has no evidence backing it, but rather that it is simply an opinion. It is also possible that that the experts have a hidden agenda or a conflict

of interest, such as when scientists funded by the oil industry produce research that says human behaviour has no effect on the climate.

Finally, the evidence may consist of an **appeal to common sense**, *a claim that appears to be sound, but lacks supporting scientific evidence*. For example, many people throughout history assumed the world was the stationary centre of the universe. The idea that the Earth could orbit the sun at blinding speeds was deemed nonsense—the force generated would seemingly cause all the people and objects to be flung into space!

In addition to common sense, beliefs can originate from other potentially unreliable sources. For example, *appeals to tradition* ("We have always done it this way!") as well as their opposite, *appeals to novelty* ("It is the latest thing!"), can lead people to believe the wrong things. Claims based on common sense, tradition, or novelty may be worthy of consideration, but whether something is true cannot be evaluated by these standards alone. Instead, what we need is careful and objective testing. What we need is science.

Module 2.1 Summary

Listen to the Audio

2.1a Know . . . the key terminology related to the principles of scientific research.

Review Module 2.1

Start Over Swap

0/23 REVIEWED · 0 MASTERED

reliability

Previous Next Got It!

2.1b Understand . . . the five characteristics of quality scientific research.

These characteristics include that (1) measurements are objective, valid, and reliable; (2) the research can be generalized; (3) it uses techniques

that reduce bias; (4) the findings are made public; and (5) the results can be replicated. For example, objective, valid, and reliable measurements make it possible for other scientists to test whether they could come up with the same results if they followed the same procedures. Psychologists typically study samples of individuals; their goal is usually to describe principles that generalize to a broader population. Single- and double-blind procedures are standard ways of reducing bias. Finally, the process of publishing results is what allows scientists to share information, evaluate hypotheses that have been confirmed or refuted, and, if needed, replicate other researchers' work.

2.1c Understand . . . how biases might influence the outcome of a study.

Demand characteristics affect how participants respond in research studies—understandably, they often attempt to portray themselves in a positive light, even if that means not answering questions or behaving in a fully truthful manner. Researchers can also influence the outcomes of their own studies, even unintentionally.

2.1d Apply . . . the concepts of reliability and validity to examples.

Try this activity to see how well you can apply these concepts.

Apply Activity

Read the following descriptions and determine whether each scenario involves an issue with reliability or validity.

1. Dr. Williams is performing very standard physiological recording techniques on human participants. Each morning he checks whether the instruments are calibrated and ready for use. One day he

discovers that although the instruments are still measuring physiological activity, their recordings are not as sensitive as on previous testing days. *Would this affect the reliability or validity of his research? Explain*.

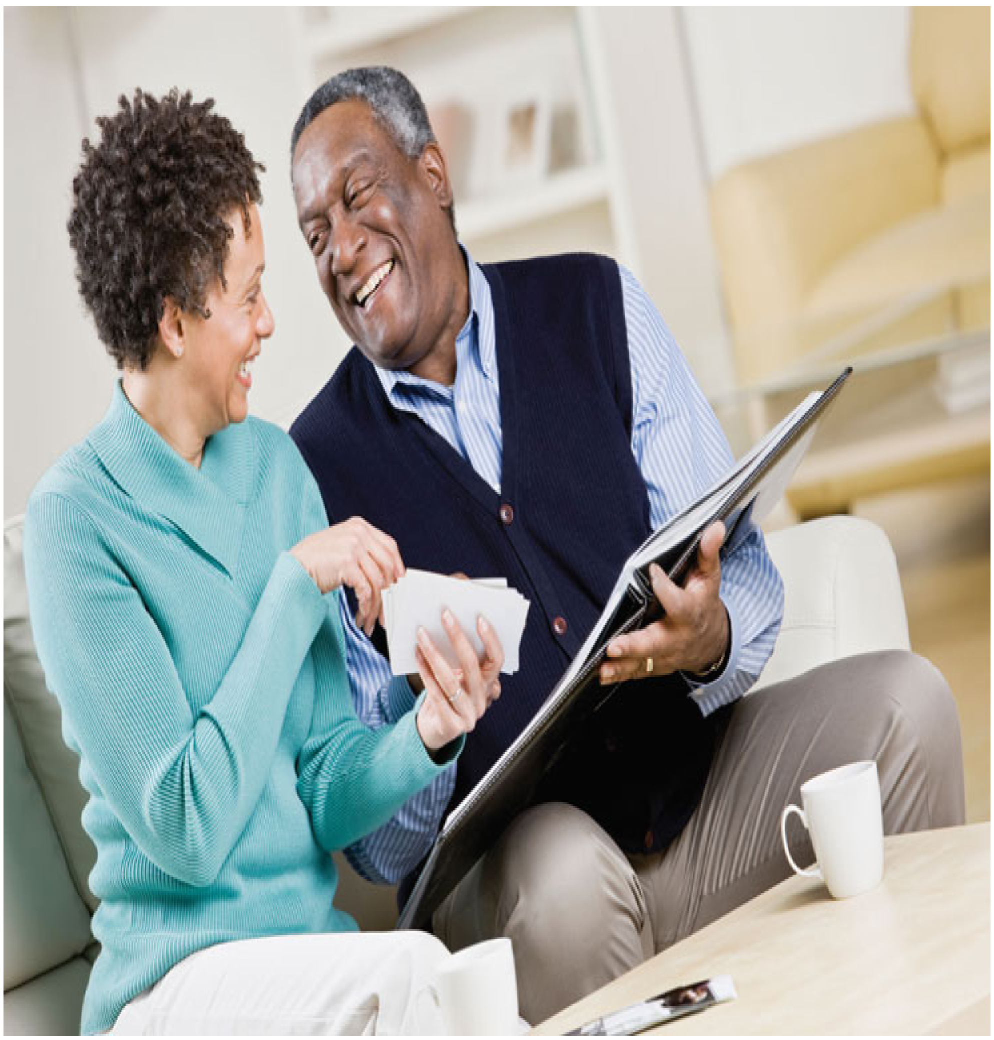
2. Dr. Nielson uses a behavioural checklist to measure happiness in the children she studies at an elementary school. Every time she and her associates observe the children, they reach near-perfect agreement on what they observed. Another group of psychologists observes the same children in an attempt to identify which children are energetic and which seem tired and lethargic. It turns out that the same children whom Dr. Nielson identifies as happy, using her checklist, are also the children whom the second group of psychologists identify as energetic. *It appears there may be a problem with Dr. Nielson's measure of happiness, or perhaps the other group's measure of energy level. Do you think it is a problem of reliability or validity? Explain*.

2.1e Analyze . . . whether anecdotes, authority figures, and common sense are reliably truthful sources of information.

To evaluate evidence, you should ask several questions. First, is someone supplying anecdotal evidence? As convincing as a personal testimony may be, anecdotal evidence is not sufficient for backing any claim that can be scientifically tested. Second, is support for the claim based on the words or endorsement of an authority figure? Endorsement by an authority figure is not necessarily a bad thing, as someone who is an authority at something should be able to back up the claim. But the authority of the individual alone is not satisfactory, especially if data gathered through good scientific methods do not support the claim. Finally, common sense also has its place in daily life, but by itself is insufficient as a final explanation for anything. Explanations based on good scientific research should override those based on common sense.

Module 2.2 Scientific Research Designs

Listen to the Audio



Andersen Ross Photography Inc/DigitalVision/Getty Images

Learning Objectives

2.2a Know . . . the key terminology related to research designs.

2.2b Understand . . . what it means when variables are positively or negatively correlated.

2.2c Understand . . . how experiments help demonstrate cause-and-effect relationships.

2.2d Apply . . . the terms and concepts of experimental methods to research examples.

2.2e Analyze . . . the pros and cons of descriptive, correlational, and experimental research designs

> *Can your attitude affect your health? This is the old question of "mind over matter," and psychologist Rod Martin from Western University in London, Ontario, thinks the answer is definitely yes. He says that if you can laugh in the face of stress, your psychological and physical health will benefit. Martin has found several interesting ways to build evidence for this argument (Martin, 2002, 2007). For example, he developed a self-report instrument that measures sense of humour. People who score high on this measure—those who enjoy a good laugh on a regular basis—appear to be healthier in a number of ways. As interesting as this evidence is, it simply illustrates that humour and health are related—there is no guarantee that one causes the other. To make such a claim, researchers would have to use the experimental method, one of the many research designs discussed in this module.*

Psychologists always begin their research with a *research question*, such as "What is the most effective way to study?", "What causes us to feel hungry?", or "How does attitude affect health?" In most cases, they also

make a prediction about the outcome they expect—the hypothesis. Psychologists then create a **research design**, *a set of methods that allows a hypothesis to be tested*. Research designs influence how investigators (1) organize the stimuli used to test the hypothesis, (2) make observations and measurements, and (3) evaluate the results. Because several types of designs are available, psychologists must choose the one that best addresses the research question and that is most suitable to the subject of their research. Before we examine different research designs, we should quickly review the characteristics that all of them have in common.

- *Variables.* A variable is a property of an object, organism, event, or something else that can take on different values. How frequently you laugh is a variable that could be measured and analyzed.
- *Operational definitions.* Operational definitions are the details that define exactly how the variable will be controlled or measured for a specific study. For sense of humour, this definition might be "the score on the Coping Humour Scale."
- *Data.* When scientists collect observations about the variables of interest, the information they record is called data. For example, data might consist of the collection of scores on the Coping Humour Scale from each individual in the sample.

These characteristics of research designs are important regardless of the design that is used. However, a number of other factors will guide the researchers as they select the appropriate research design for their topic of interest.

Descriptive Research

Listen to the Audio

The beginning of any new line of research must involve descriptive data. Descriptive research answers the question of “what” a phenomenon is; it describes its characteristics. Once these observations have been performed and the data examined, they can be used to inform more sophisticated future studies that ask “why” and “how” that phenomenon occurs.

These descriptions can be performed in different ways. **Qualitative research** *involves examining an issue or behaviour without performing numerical measurements of the variables*. In psychology, qualitative research often takes the form of interviews in which participants describe their thoughts and feelings about particular events or experiences (Madill & Gough, 2008). For example, researchers at St. Francis Xavier University in Nova Scotia performed a qualitative study of how males and females experienced “friends with benefits” relationships (Weaver et al., 2011). As you likely know, “friends with benefits” refers to sexual activity that occurs between partners who do not view the relationship as being romantic. In this study, the researchers performed a semi-structured interview with 16 female and 10 male students. Although the interview contained six primary questions that would be asked over the course of the meeting, the interviews varied widely from person to person, as each individual had a different experience with their friends-with-benefits relationship. In this case, the fact that the researchers weren’t restricted to numerical data helped them answer their research question.

Quantitative research, on the other hand, *involves examining an issue or behaviour by using numerical measurements and/or statistics*. The majority of psychological studies are quantitative in nature. These designs can involve complex manipulations (discussed later in this module); but, it is also possible to perform more descriptive studies using numbers. For instance, if you wanted to examine friends-with-benefits quantitatively, you could conduct an interview or survey in which participants provided specific responses to questions (e.g., "On a scale of 1 [sad] to 7 [happy], how did you feel when your friends-with-benefits relationship ended?").

Here are a few other examples of descriptive research questions:

- How many words can the average two-year-old speak?
- How many hours per week does the typical university student spend on homework?
- What proportion of the population will experience depression or an anxiety disorder at some point in their lives?

As you can see, research questions can address the appearance of a behaviour, its duration or frequency, its prevalence in a population, and so on. To answer these questions, researchers usually gather data using one or more of the following designs: *case studies*, *naturalistic observation*, and *surveys and questionnaires*.

Case Studies

Listen to the Audio

A **case study** *is an in-depth report about the details of a specific case*. Rather than developing a hypothesis and then objectively testing it on a number of different individuals, scientists performing a case study describe an individual's history and behaviour in great detail. Of course, case studies are not performed on just anyone. They are generally reserved for individuals who have a very uncommon characteristic or have lived through a very unusual experience.

Perhaps the most famous case study in psychology (and neuroscience) is that of Phineas Gage (1823–1860). Gage was a foreman working for the Rutland and Burlington Railroad Company in the northeastern U.S. state of Vermont. On September 13, 1848, 25-year-old Gage was helping his crew blast through a rocky outcrop near the town of Cavendish and was involved in an accident that caused an iron rod to be propelled upwards underneath Gage's eye and through his head. According to the original medical report of the incident (Harlow, 1848; available online for interested readers), the iron rod was found 25 m away, suggesting that it was travelling very quickly as it tore through Gage's brain.

Amazingly, Gage survived the accident, although his physical recovery took most of a year (Bigelow, 1850; Harlow, 1849). However, it quickly became apparent that Gage's injuries were not limited to physical damage; his mental state had also been affected. Reports indicate that while he had been a reputable citizen prior to the accident, afterward he

became much more impulsive, inconsiderate, indecisive, and impatient. According to Harlow (1868), Gage’s friends claimed that the changes were so pronounced that he “was no longer Gage.” The doctors treating Gage rightfully concluded that these sudden changes were due to the brain damage that he had suffered. Examination at the time of the accident—which involved Dr. Harlow sticking his finger into the hole in Gage’s head—suggested that this damage was located in the frontal lobes of the brain, a region now known to be involved in a number of complex behaviours including decision making and emotional regulation (see Modules 8.2 and 11.4).

Interestingly, over the course of a few years, Gage slowly recovered enough of his self-control to hold down different jobs, including one as a long-distance stagecoach driver in South America (Macmillan, 2008). However, he continued to have difficulties maintaining social relationships. Had doctors paid more attention to this partial recovery, it would have been one of the first reported cases of the brain's ability to compensate and repair itself after injury.

Because Gage’s case was documented in a series of detailed case-study reports, it was possible for future doctors and researchers to use this information to gain a better understanding of the role of the frontal lobes and the problems that emerge when this brain area is damaged.

Phineas Gage proudly holding the tamping iron that nearly killed him, and that made him one of the most famous names in the history of psychology and neuroscience.

Warren Anatomical Museum in the Francis A. Countway Library of Medicine. Gift of Jack and Beverly Wilgus

Although case studies tell us a lot about an individual's condition, is it really science? Different researchers have different opinions about the merit of such reports, with some viewing them as important scientific contributions and others viewing them as simply interesting stories.

Of course, case studies are often limited to individuals with unique conditions or experiences. They cannot be used to answer all types of research questions. For instance, there are times when a researcher might be interested in how groups of people or animals behave in environments outside of the controlled laboratory setting or interview room. In these situations, an entirely different form of descriptive research is necessary to examine psychological behaviours.

Working the Scientific Literacy Model

Case Studies as a Form of Scientific Research

Listen to the Audio

Case studies allow the clinician or researcher to present more details about an individual than would be possible in a research report involving a number of participants; however, this detail comes at a price. Is a thorough description of a single individual still a form of science or is it simply an example of anecdotal evidence?

What do we know about using case studies as a form of scientific research?

Case studies have been a form of psychological research for over a century. Sigmund Freud (introduced in Module 1.2) used case studies of unique patients when he initially described many of his theories of personality and development. Case studies have also been critical for our understanding of the brain. Phineas Gage was just one of many unique neurological patients who have taught us how different areas of the brain influence particular behaviours. In each situation, the researchers described their patient in great detail so the case study could improve the treatment of similar patients in the future.

Case studies can also be useful in describing symptoms of psychological disorders and providing detailed descriptions about specific successes or failures in their treatment. One recently

published example of a case study did both (Elkins & Moore, 2011). The authors of this study described the experience of a certain type of anxiety disorder and the steps used in therapy to treat the anxiety over a 16-week period. They were able to document how and when changes occurred and the effects of the treatment on other aspects of the individual's life. This level of detail would not be available if the authors had not focused on a single case. However, as case studies only describe a single individual, there is no guarantee that the findings can be generalized to other people and situations.

How can science test the usefulness of case studies?

Although it is tempting to view case studies as simply being descriptions of an individual, they can also serve another important scientific function: They can be used to test an existing hypothesis. For example, until a couple of years ago, researchers thought that the amygdala—a fear centre in the brain—was essential for emotional information to grab our attention (e.g., the way your attention is almost always drawn to a spider walking across your ceiling). It made sense that a fear centre would be a necessary part of a fear response. Brain-imaging studies showed that this structure was active when these types of images were displayed to healthy participants. But, what would happen if someone with no amygdala on either side of their brain was put in this situation? A case study with one such patient (there are fewer than 300 worldwide) found that her attention was still grabbed by emotional stimuli (Tsuchiya et al., 2009). This told researchers that their models of how emotion and attention work together were too simplistic, and forced them to look at other brain structures that could be influencing these processes. In other words, the case study was used not to

generate hypotheses, but to actually test an existing scientific theory.

How can we critically evaluate the role of case studies in research?

The previous section demonstrates that case studies can help guide our understanding of existing scientific theories. Case studies can also be used to help scientists form hypotheses for future research studies. Take Phineas Gage, for example. Although there are very few, if any, other reports of individuals experiencing a tamping rod shooting through their frontal lobes, patients who suffered damage to the frontal lobes after car accidents and strokes have noted impairments similar to those suffered by Gage. Specifically, these individuals became more impulsive and risk-prone than they had been before their accident (Bechara et al., 1994; Damasio, 1994). Researchers have also created lesions similar to Phineas Gage's in animal subjects (e.g., laboratory rats) and observed similar tendencies (Quirk & Beer, 2006).

Researchers can also use computer simulations to model the effects of this form of brain damage. In one study—cheekily entitled "Spiking Phineas Gage"—Brandon Wagar and Paul Thagard (2004) of the University of Waterloo created a computerized neural network that used both cognitive and emotional information to produce simple decisions. After the network "learned" the task, the researchers altered its parameters so that the frontal lobe node of the network did not function properly. As predicted, this network's responses quickly became more dependent upon emotional impulses, just like patients with frontal-lobe damage such as Gage.

Why is this relevant?

These studies demonstrate that case studies are not simply anecdotes that scientists tell each other when they sit around the campfire. The case study of a single patient who somehow survived a terrifying brain injury has stimulated hundreds of scientific research papers leading to improvements in our understanding of how the brain works. Fittingly, such information will be essential in the treatment of any modern-day Phineas Gages. As you continue reading this text, you'll be introduced to a number of unique individuals whose stories have informed and guided psychological science for over a century. Without them, our understanding of topics ranging from vision to memory to language to emotions would not be as sophisticated as it has become. These topics would also lack the story-like narratives that make psychology so compelling.

Naturalistic Observation

Listen to the Audio

An alternative form of descriptive research is to observe people (or animals) in their natural settings. When psychologists engage in such **naturalistic observations**, *they unobtrusively observe and record behaviour as it occurs in the subject's natural environment*. The key word here is *unobtrusively*; in other words, the individuals being observed shouldn't know that they are being observed. Otherwise, the mere act of observation could change the participants' behaviours (imagine how your conversations with friends would change if you knew a psychologist was listening and taking notes). Most students have seen television programs about scientists in search of chimpanzees in a rain forest or driving a Range Rover in pursuit of a herd of elephants. This certainly is a form of observation, but there is more to it than just watching animals in the wild. When a scientist conducts naturalistic observation research, they are making systematic observations of specific variables according to operational definitions. By having a very precise definition of what a variable is and how it will be measured, researchers using naturalistic observations can improve the reliability of their work. In other words, they can ensure that their results are objective and that different people observing the same environment would score the behaviours in the same way (e.g., two observers would both call the same activity by a chimpanzee a grooming behaviour).

Although it may appear that naturalistic observation is only useful for animal studies or nature programs on TV, there have been a number of

interesting human-focused naturalistic observation studies conducted as well. For example, a study conducted by psychologists at Carleton University in Ottawa measured the behaviour of spectators at youth hockey games (Bowker et al., 2009). These researchers were specifically interested in the types of comments made by spectators—the intensity of the remarks, who made them (male vs. female), and who they were directed toward (players, other spectators, or everyone's favourite target, the referees), among other variables. They also examined whether the observed trends changed depending upon whether the game was in a highly competitive or a more recreational league. The researchers found that females made more comments than males; these comments were largely positive and directed toward the players. Males tended to make more negative comments as well as directions on how to improve play (e.g., "Skate faster!"). Both female and male spectators made more negative comments when watching competitive, as opposed to recreational, leagues; these comments were largely directed toward the referees. Based on these observations, which involved five observers attending 69 hockey games, the researchers concluded that the behaviour of spectators is not as negative and unsettling as is often reported in the media (Bowker et al., 2009).

Thus, naturalistic observations can occur anywhere that behaviours occur, be it in "nature," in a hockey rink, or even in a bar (Graham & Wells, 2004). The key point is that the researchers must pay attention to specific variables and use operational definitions. However, naturalistic observations may not always provide researchers with the specific types of information they are after. In these cases, researchers may need to adopt a different research strategy in order to describe a given behaviour.

Surveys and Questionnaires

Listen to the Audio

Another common method of descriptive research used by psychologists is **self-reporting**, *a method in which responses are provided directly by the people who are being studied, typically through face-to-face interviews, phone surveys, paper and pencil tests, and web-based questionnaires*. These methods allow researchers to assess attitudes, opinions, beliefs, and abilities. Despite the range in topics and techniques, their common element is that the individuals speak for themselves. Surveys and questionnaires are still a method of observation, but the observations are provided by the people who are being studied rather than by the psychologist.

Although this method initially sounds simple, the creation of objective survey and questionnaire items is extremely challenging. Care must be taken not to create biased questions that could affect the results one way or another. If you're interested in studying emotional sensitivity, you can't ask, "Given that men are drooling pigs, how likely are they to notice when someone is unhappy?" Similarly, if you're studying a subject that some individuals might not want to openly discuss, it is important to develop questions that touch on the issue without being too off-putting. For example, asking people, "How depressed are you?" and giving them a 7-point scale might not work, as some respondents might not want to state that they are depressed. But questionnaires can tap into the symptoms of depression by asking questions about energy levels, problems with sleeping, problems concentrating, and changes in their

mood. The researchers could then use the responses for these questions to determine if a respondent was depressed.

This leads to an important question: How do researchers figure out if their questions are valid? For clinical questionnaires, the researchers can compare results to a participant's clinical diagnosis. For questionnaires examining other phenomena, researchers perform a large amount of pretesting in order to calculate *norms*, or average patterns of data. Almost all of the questionnaires that you will encounter as a psychology student will have undergone prior testing to establish norms and to confirm that the research tool is both valid and reliable. This testing will involve hundreds or even thousands of participants; their efforts help ensure that self-report measures such as questionnaires are a useful tool in psychology's quest to understand different behaviours.

Correlational Research

Listen to the Audio

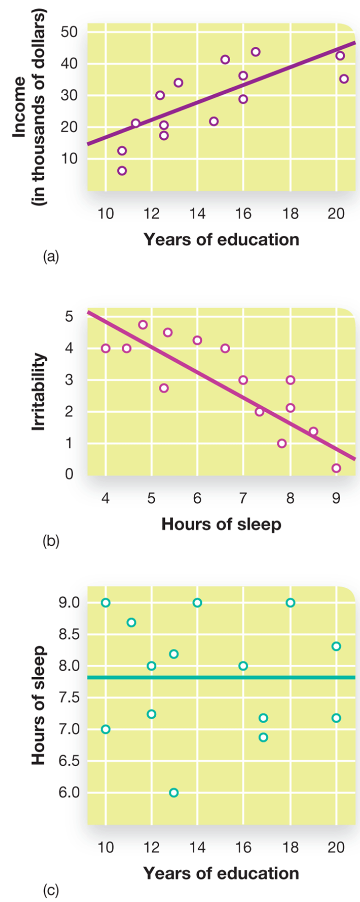
Psychologists performing descriptive research almost always record information about more than one variable when they are collecting data. In these situations, the researchers are engaged in **correlational research** *measuring the degree of association between two or more variables*. For example, consider these two questions:

- What is the average education level of Canadians over the age of 30?
- What is the average income of Canadians over the age of 30?

These two questions ask for different types of information, but their answers may be related. Is it likely that people with higher education levels also tend to have higher income levels? By asking two or more questions—perhaps through a survey—researchers can start to understand the associations among variables.

Correlations can be visualized when presented in a graph called a *scatterplot*, as shown in Figure 2.4. In scatterplot (a), you can see the data for education and income. Each dot represents one participant's data; when you enter dots for all of the participants, you may see a pattern emerge. In this case, the dots show a pattern that slopes upward and to the right, indicating that people with higher education levels tend to have a higher average income. That correlation is not surprising, but it illustrates one of the two main characteristics that describe correlations:

Figure 2.4 Correlations Are Depicted in Scatterplots



Here we see two variables that are positively correlated (a) and negatively correlated (b). In the example of a zero correlation (c), there is no relationship between the two variables.

- *Direction:* The pattern of the data points on the scatterplot will vary based on the relationship between the variables. If correlations are *positive* (see Figure 2.4a), it means that the two variables change values in the same direction. So, if the value of one variable increases, the value of the other variable also tends to increase, and if the value of one variable decreases, the value of the other variable decreases. For example, education levels and average income both tend to rise and fall together, with educated people tending to be wealthier. In contrast, if correlations are *negative* (see Figure 2.4b), it means that

as the value of one variable increases, the value of the other variable tends to decrease. For instance, if you get a lot of sleep, you are less likely to be irritable; but, if you don't get much sleep, then you will be more likely to be irritable.

- *Magnitude* (or strength): This refers to how closely the changes in one variable are linked to changes in another variable (e.g., if variable A goes up one unit, will variable B also go up one unit?). This magnitude is described in terms of a mathematical measure called the *correlation coefficient*. A correlation coefficient of zero means that there is no relationship between the two variables (see Figure 2.4c). A coefficient of +1.0 means that there is a very strong positive correlation between the variables (+1.0 is the most positive correlation coefficient possible). A coefficient of −1.0 means that there is a very strong negative correlation between the variables (−1.0 is the most negative correlation coefficient possible). Importantly, +1.0 and −1.0 coefficients have an equal magnitude or strength; however, they have a different direction.

You will encounter many correlations in this text, and it will be important to keep in mind the direction of the relationship—whether the variables are positively or negatively associated. One key point to remember is that the correlation coefficient is a measure of association only—*it is not a measure of causality*. In other words, correlation does not equal causation. This is an extremely important point!

In many cases, a correlation gives the *impression* that one variable causes the other, but that relationship cannot be determined from correlational research. For example, we noted in the beginning of the module that a sense of humour is associated with good health—this is a positive correlation. But this does not mean that humour *is responsible for* the good health. Perhaps good health leads to a better sense of humour. Or perhaps neither causes the other, but rather a third variable causes both

good health and good sense of humour. This possibility is known as the **third variable problem**, *the possibility that a third, unmeasured variable is actually responsible for a well-established correlation between two variables*. Consider the negative correlation between sleep and irritability shown in the scatterplot (b) of Figure 2.4. Numerous third variables could account for this relationship. Stress, depression, diet, and workload could *cause* both increased irritability and lost sleep. As you can see, correlations must be interpreted with caution.

Myths in Mind

Beware of Illusory Correlations

Chances are you have heard the following claims:

- Crime and emergency room intakes suddenly increase when there is a full moon.
- Opposites attract.
- Competitive basketball players (and even gamblers) get on a "hot streak" where one success leads to the next.

Many common beliefs such as these are deeply ingrained in our culture. They become even more widely accepted when they are repeated frequently. It is difficult to argue with a hospital nurse or police officer who *swears* that full-moon nights are the busiest and craziest of all. The conventional, reserved, and studious man who dates a carefree and spirited woman *confirms* that opposites attract. And, after Kyle Lowry has hit a few amazing jump shots for the Toronto Raptors, of course his chances of success just get better and better as the game wears on.

But do they? Each of these three scenarios is an example of what are called **illusory correlations**—*relationships that really exist only in the mind, rather than in reality*. It turns out that well-designed studies have found no evidence that a full moon leads to, or is even related to, bizarre or violent behaviour (Lilienfeld & Arkowitz, 2009). People who are attracted to each other are typically very similar (Buston & Emlen, 2003). Also, although some games may be better than others, overall the notion of a "hot streak" is not a reality in basketball or in blackjack (Caruso et al., 2010; Gilovich et al., 1985).

Why do these illusory correlations exist? Instances of them come to mind easily and are more memorable than humdrum examples of "normal" nights in emerg, perfectly matched couples, and all of the times Kyle Lowry missed a shot, even in his best games. However, just because examples are easy to imagine, it does not mean that this is what typically occurs.

Contrary to popular belief, a full moon is statistically unrelated to unusual events or increased emergency room visits.

Left: gary yim/Shutterstock; right: Florian Franke/Corbis

Experimental Research

Listen to the Audio

Experimental designs improve on descriptive and correlational studies because they are the only designs that can provide strong evidence for cause-and-effect relationships. Like correlational research, experiments have a minimum of two variables, but there are two key differences between correlational research and experiments: the *random assignment* of the participants and the researcher's *experimental control* over the variables being studied. As you will see, these unique features are what make experimental designs so powerful.

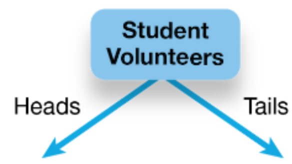
The Experimental Method

Listen to the Audio

Imagine you were conducting an experiment testing whether seeing photographs of nature scenes would reduce people's responses to stressful events. You carefully created two sets of images—one of peaceful images of the British Columbia rain forests, Lake Louise, Algonquin Park in Ontario, and rugged Maritime coastlines—and another of neutral images such as houses. When the first two participants arrive at the laboratory for your study, one is wearing a t-shirt supporting a local environmental organization and the other is wearing a t-shirt emblazoned with an oil sands company logo. Which participant gets assigned to the nature scene condition and which gets assigned to the neutral condition? If you are conducting an objective, unbiased study, the answer to this question is that either participant is equally likely to be assigned to either condition. Indeed, a critical element of experiments is **random assignment**, *a technique for dividing samples into two or more groups in which participants are equally likely to be placed in any condition of the experiment*. Random assignment allows us to assume the two groups will be roughly equal (Figure 2.5).

Figure 2.5 Elements of an Experiment

Hypothesis: Nature causes a reduction in stress.



If we wanted to test whether exposure to nature-related images causes a reduction in stress (as is assumed by people who have nature scenes as their computer's wallpaper), we would first need to randomly assign people in our sample to either the experimental or control condition.

1 of 3 Previous Next

If we assigned anyone who looked like they were nature lovers to the nature scene condition, then our experiment might not be telling us about the effects of the images. Instead, some other **confounding variable**—*a variable outside of the researcher's control that might affect or provide an alternative explanation for the results*—could potentially enter the picture. In our example, the variables of political awareness or tendency to be "outdoorsy" might play an even larger role in the study than the stimuli you worked so hard to create. Randomly assigning participants to the different experimental conditions also allows the researcher to assume that other sources of variability such as mood and personality are evenly spread across the different conditions. This allows you to infer that any differences between the two groups are because of the variable you are testing.

In this experiment, we are manipulating one variable (the types of images being viewed) and measuring another variable (stress response). *The variable that the experimenter manipulates to distinguish between two or more groups* is known as the **independent variable**. The participants cannot

alter these variables, as they are controlled by the researcher. In contrast, the **dependent variable** *is the observation or measurement that is recorded during the experiment and subsequently compared across all groups*. The levels of this variable are dependent upon the participants' responses or performance. In our example, the type of images being viewed is the independent variable and the participants' stress response is the dependent variable.

This experiment is an example of a **between-subjects design**, *an experimental design in which we compare the performance of participants who are in different groups*. One of these groups, the **experimental group**, *is the group in the experiment that receives a treatment or the stimuli targeting a specific behaviour*, which in this specific example would be exposure to nature scenes. The experimental group always receives the treatment. In contrast, the **control group** *is the group that does not receive the treatment or stimuli targeting a specific behaviour; this group therefore serves as a baseline to which the experimental group is compared*. In our example, the control group would not be exposed to nature photographs. What if the experimental group showed reduced stress compared to the control group? Assuming that the experiment was well designed and all possible confounds were accounted for, the researchers could conclude that the independent variable—exposure to images of nature—is responsible for the difference. A between-subjects design allows the researcher to examine differences between groups; however, it is also open to criticism. What if the two groups were different from each other simply by chance? That would make it more difficult to detect any differences caused by your independent variable. In order to reduce this possibility, researchers often use **within-subjects designs**, *an experimental design in which the same participants respond to all types of stimuli or experience all experimental conditions*. In the experiment we've discussed in this section, a within-subjects design would have involved participants viewing all of the images from one condition (e.g., nature photographs) before being tested,

and then viewing all of the images from the other condition (e.g., neutral photographs) before being tested again. In this case, the order of the conditions would be randomly assigned for each participant.

As you can see, designing an experiment requires the experimenter to make many decisions. However, in some cases, some of these decisions are taken out of the researchers' hands.

The Experimental Method

The experimental method involves a number of specialized terms. To ensure that you are learning them, match each term below with the example that best illustrates the term.

A researcher is testing whether mindfulness meditation reduces negative mood in people diagnosed with depression.

In this study, the use of meditation is the ______ and the symptoms of negative mood make up the ______. She knows that some people will improve over time with or without meditation. Therefore "time" is potentially a ______. To rule out "time" as a potential effect, she creates two groups. The ______ will be led in mindfulness meditation sessions. The ______ will not participate in mindfulness training, but will be observed for the same amount of time. For each volunteer that participates in this study, the researcher flips a coin to determine which group they will participate in. This is a method of ______. Because the individuals are placed into separate groups, this study represents a ______.

WORD BANK

- dependent variable
- control group
- experimental group
- independent variable
- confounding variable
- between-subjects design
- random assignment

Start Over | Check Answers

I>

The Quasi-Experimental Method

Listen to the Audio

Random assignment and manipulation of a variable are required for experiments. They allow researchers to make the case that differences between the groups originate from the independent variable. In some cases, though, random assignment is not possible. **Quasi-experimental research** *is a research technique in which the two or more groups that are compared are selected based on predetermined characteristics, rather than random assignment*. For example, you will read about many studies in this text that compare men and women. Obviously, in this case one cannot flip a coin to randomly assign people to one group or the other. Also, if you gather one sample of men and one sample of women, they could differ in any number of ways that are not necessarily relevant to the questions you are studying. As a result, all sorts of causes could account for any differences that would appear: genetics, gender roles, family history, and so on. Thus, quasi-experiments are essentially correlational; they can point out relationships among pre-existing groups, but they cannot determine what it is about those groups that leads to the differences.

Converging Operations

Listen to the Audio

An underlying theme of this module has been that each method of studying behaviour has benefits as well as limitations (see Table 2.1). For example, naturalistic observation research allows psychologists to see behaviour as it normally occurs, but it makes experimental control very difficult—some would argue impossible. Conversely, to achieve true random assignment while controlling for any number of confounding variables and outside influences, the situation may be made so artificial that the results of an experiment do not apply to natural behaviour. Luckily, psychologists do not have to settle on only one method of studying behaviour. Most interesting topics have been studied using a variety of possible designs, measures, and samples. In fact, when a theory's predictions hold up to dozens of tests using a variety of designs—a perspective known as *converging operations*—we can be much more confident of its accuracy, and are one step closer to understanding the many mysteries of human (and animal) behaviour.

Table 2.1 Strengths and Limitations of Different Research Designs

Table 2.1 Strengths and Limitations of Different Research Designs

Method	Strengths	Limitations
Case studies	Yields detailed information, often of rare conditions or observations	The focus on a single subject limits generalizability
Naturalistic observation	Allows for detailed descriptions of subjects in environments where behaviour normally occurs	Poor control over possibly influential variables
Surveys/questionnaires	Quick and often convenient way of gathering large quantities of self-report data	Poor control; participants may not answer honestly, written responses may not be truly representative of actual behaviour
Correlational study	Shows strength of relationships between variables	Does not allow researcher to determine cause-and-effect relationships
Experiment	Tests for cause-and-effect relationships; offers good control over influential variables	Risk of being artificial with limited generalization to real-world situations

Module 2.2 Summary

Listen to the Audio

2.2a Know . . . the key terminology related to research designs.

Review Module 2.2

Start Over Swap

0/18 REVIEWED · 0 MASTERED

correlational research

Previous Next Got It!

2.2b Understand . . . what it means when variables are positively or negatively correlated.

When two or more variables are positively correlated, their relationship is direct—they increase or decrease together. For example, income and education level are positively correlated. Negatively correlated variables

are inversely related—as one increases, the other decreases. Substance abuse may be inversely related to cognitive performance—higher levels of substance abuse are often associated with lower cognitive functioning.

2.2c Understand . . . how experiments help demonstrate cause-and-effect relationships.

Experiments rely on randomization and the manipulation of an independent variable to show cause and effect. At the beginning of an experiment, two or more groups are randomly assigned—a process that helps ensure that the two groups are roughly equivalent. Then, researchers manipulate an independent variable; perhaps they give one group a drug and the other group a placebo. At the end of the study, if one group turns out to be different, that difference is most likely due to the effects of the independent variable.

2.2d Apply . . . the terms and concepts of experimental methods to research examples.

Here are two examples for practice.

Apply Activity

Apply Activity

Applying Your Knowledge of Research Terms to Understand Research Designs

Dr. Vincent randomly assigns participants in a study to exercise versus no exercise conditions and, after 30 minutes, measures mood levels. In this case, exercise level is the __________ .

Dr. Vincent will administer a self-report mood survey to measure the __________ .

Dr. Harrington surveyed students on multiple lifestyle measures. She discovered that as the number of semesters that university students complete increases, their anxiety level increases. If number of semesters and anxiety increase together, this is an example of a(n) __________ .

Dr. Harrington also found that the more time students spent socializing, the less likely they were to become depressed. The increase in socializing and decrease in depression is an example of a(n) __________ .

WORD BANK

- positive correlation
- independent variable
- dependent variable
- negative correlation

Start Over | Check Answers

2.2e Analyze . . . the pros and cons of descriptive, correlational, and experimental research designs.

Descriptive methods have many advantages, including observing naturally occurring behaviour and providing detailed observations of individuals. In addition, when correlational methods are used in descriptive research, we can see how key variables are related. Experimental methods can be used to test for cause-and-effect relationships. One drawback is that laboratory experiments might not generalize to real-world situations.

Module 2.3 Ethics in Psychological Research

Listen to the Audio

Bettmann/Getty Images

Learning Objectives

2.3a Know . . . the key terminology of research ethics.

2.3b Understand . . . the importance of reporting and storing data.

2.3c Understand . . . why animals are often used in scientific research.

2.3d Apply . . . the ethical principles of scientific research to examples.

2.3e Analyze . . . the role of using deception in psychological research.

In the early 1950s, the United States' Central Intelligence Agency (CIA) became involved in the field of psychology. After hearing that their enemies in the Soviet Union, China, and North Korea had tried to use mind-control techniques—including mind-altering drugs—on U.S. prisoners of war, the CIA felt it had no choice but to research these techniques themselves. Project MKUltra began. After recruiting former Nazi scientists who had studied torture and "brainwashing" during World War II (and who had been prosecuted as war criminals), the CIA secretly poured tens of millions of dollars into research laboratories at hospitals and universities in order to study mind-control techniques that would alter people's personalities, memories, and ability to control themselves while being interrogated. At least one of these institutions was in Canada.

Scottish psychiatrist Donald Ewen Cameron used CIA funds (as well as $500 000 from the Canadian government) to perform terrifying experiments at the Allan Memorial Institute of McGill University from 1957 to 1964. Patients who were admitted to the institute for fairly minor problems such as anxiety disorders or depression were—without giving proper consent or being informed of the reason for the "treatment"—subjected to manipulations that can only be called torture. These patients received drugs that caused temporary paralysis or even coma, electroconvulsive therapy set at more than 30 times the recommended strength, constant noises, and even looped tapes

repeating messages (Klein, 2007). These treatments led to amnesia, confusion, and anxiety; participants in these programs were never the same (Collins, 1988).

Project MKUltra was officially ended in 1973. The experiments are now generally accepted as being among the most unethical studies in the history of science. In the 1980s, the Canadian government paid $100 000 to each of the 127 victims of Cameron's unauthorized research program. For several decades, the CIA's interrogation manual referred to "studies at McGill University" (McCoy, 2006).

The topics that psychologists study deal with living, sensing organisms, which raises a number of ethical issues that must be addressed before any study begins. These concerns include protecting the physical and mental well-being of participants, obtaining consent from them, and ensuring that their responses remain confidential. The procedures discussed in the next section have been developed as protections for participants; they are critical not only to ensure the individual well-being of the study participants, but also to maintain a positive and trustworthy image of the scientists who conduct research.

Promoting the Welfare of Research Participants

Listen to the Audio

The CIA mind-control research program certainly is an extreme case—extreme in the harm done to the volunteers, the disregard for their well-being, and its secretive nature. Today, most research with human participants involves short-term, low-risk methods, and there are now ethical guidelines and procedures for ensuring the safety and well-being of all individuals involved in research. In Canada, all institutions that engage in research with humans, including colleges and universities, are required to have a **research ethics board (REB)**, *a committee of researchers and officials at an institution charged with the protection of human research participants*. (If you read a research report from an American institution, they will refer to Institutional Review Boards [IRBs]; these are the same thing as REBs.) REBs help ensure that researchers abide by the ethical rules set out in the *Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (2nd edition)*, a set of requirements created by the Government of Canada's Panel of Research Ethics. The REBs are intended to protect individuals in two main ways: (1) The committee weighs potential risks to the volunteers against the possible benefits of the research, and (2) it requires that volunteers agree to participate in the research (i.e., they give informed consent).

Weighing the Risks and Benefits of Research

Listen to the Audio

The majority of psychological research, such as computer-based studies of perception or questionnaires studying personality traits, involves minimal exposure to physical or mental stress. Even so, great care is taken to protect participants. Some research involves more risk, such as exposing individuals to brief periods of stress, inducing a negative mood, asking about sensitive topics, or even asking participants to engage in brief periods of exercise. Some studies have even exposed humans to the virus that causes the common cold, or made small cuts to the skin to study factors that affect healing. The benefits that this type of research provides in promoting health and well-being must be weighed against the short-term risks to the people who consent to participate in these studies.

It must be stressed that physical risks are relatively less common in psychological research as compared to cognitive and emotional stress. For example, think about a volunteer who experienced recent trauma such as the death of a loved one or a violent crime. They might be asked to answer questions or write about that experience in great detail, sometimes repeatedly. Engaging in that activity is likely to stir up powerful and unpleasant emotions, so the researchers must put safeguards in place to reduce that risk. This would include informing potential volunteers before they begin the study, and allowing individuals to withdraw from the research at any time they choose. Finally, once the study is completed, researchers should make sure the participants are not

in significant distress and that they are able to access social support or professional help if needed.

Another source of risk is related to the fact that some studies ask participants to provide the experimenter with sensitive and/or personal information. Think about all the topics in psychology that people might want to keep to themselves: opinions about teachers or supervisors, a history of substance abuse, criminal records, medical records, internet search history, and so on. Disclosing this information is a potential threat to a person's reputation, friends, and family. Psychologists must find ways to minimize these risks so that participants do not suffer any unintended consequences of participating in psychological research.

Indeed, everyone involved in the research process—the researcher, the REB, and the potential volunteer—must determine whether the study's inherent risks are worth what can potentially be learned if the research goes forward. Consider again the stressors mentioned previously:

> *Research about trauma.* Although revisiting a stressful experience can be difficult, researchers learn how coping through expression can help emotional adjustment and physical health. In fact, participants who write about stress tend to be healthier—emotionally and physically—than those who write about everyday topics (such as describing their dorms or apartments).
>
> *Reporting sensitive, private information.* Many individuals in recovery from alcohol or drug addiction prefer to remain anonymous. However, if they share their experiences in a confidential and anonymous way, psychologists can learn about the common experiences that put people at a higher risk for addiction.

These stressful situations have potential benefits that can be applied to other people. The psychologists who undertake such research tend to be motivated by several factors—including the desire to help others, the drive to satisfy their intellectual curiosity, and even their own livelihood and employment. The REB serves as a third party that weighs the risks and benefits of research without being personally invested in the outcome. Under today's standards, there is no chance that the CIA mind-control studies would have been initiated, except in secrecy outside of the public process of science. The danger to the participants in that study—*victims* might be a better term—far outweighed any scientific benefit gained from the experiments, even if the participants had known what they were getting into. Today, it is mandatory that research participants be informed of any risks to which they may be exposed and willfully volunteer to take part in a study.

Obtaining Informed Consent

Listen to the Audio

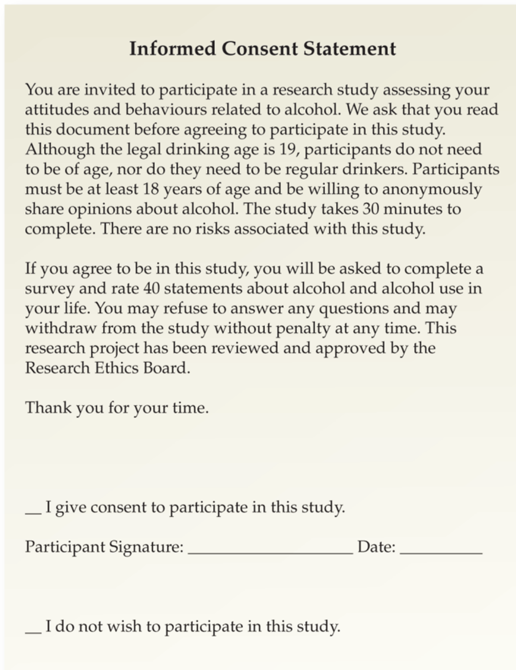
In addition to weighing the risks versus the benefits of a study, researchers must ensure that human volunteers truly are *volunteers*. This may seem redundant, but it is actually a tricky issue. Recall that the human subjects in the CIA mind-control studies were volunteers only in the sense that they voluntarily sought treatment from the researchers. But did they volunteer to undergo procedures that were very close to being torture? Had the men and women known the true nature of the study, it is doubtful that any would have continued to participate. Currently, participants and patients have much more protection than they did in the 1950s and 1960s. Before any experimental procedures begin, all participants must provide **informed consent**: *A potential volunteer must be informed (know the purpose, tasks, and risks involved in the study) and give consent (agree to participate based on the information provided) without pressure*.

To be truly informed about the study, volunteers should be told, at minimum, the following details (see also Figure 2.6):

- the topic of the study
- the nature of any stimuli to which they will be exposed (e.g., images, sounds, smells)
- the nature of any tasks they will complete (e.g., tests, puzzles)
- the approximate duration of the study
- any potential physical, psychological, or social risks involved

- the steps that the researchers have taken to minimize those risks

Figure 2.6 Informed Consent



Informed Consent Statement

You are invited to participate in a research study assessing your attitudes and behaviours related to alcohol. We ask that you read this document before agreeing to participate in this study. Although the legal drinking age is 19, participants do not need to be of age, nor do they need to be regular drinkers. Participants must be at least 18 years of age and be willing to anonymously share opinions about alcohol. The study takes 30 minutes to complete. There are no risks associated with this study.

If you agree to be in this study, you will be asked to complete a survey and rate 40 statements about alcohol and alcohol use in your life. You may refuse to answer any questions and may withdraw from the study without penalty at any time. This research project has been reviewed and approved by the Research Ethics Board.

Thank you for your time.

__ I give consent to participate in this study.

Participant Signature: ________________ Date: _________

__ I do not wish to participate in this study.

Research participants must provide informed consent before taking part in any study. As shown here, the participant must be made aware of the basic topic of the study as well as any possible risks.

Ethical practices often involve resolving conflicting interests, and in psychological research the main conflict is between the need for informed consent and the need for "blinded" volunteers. (Recall from Module 2.1 that in the best experimental designs the participants are *blinded*—they do not know exactly what the study is about, because such information may lead to subject bias.) For example, a social psychologist might want to *observe unconscious mimicry*—the tendency for people to take on the gestures, postures, or other physical mannerisms of others during a conversation. If participants knew this going into the study, they would find it very difficult to behave naturally and would likely spend more time

aware of their body than the topic of conversation. In these cases, researchers use **deception**—*misleading or only partially informing participants of the true topic or hypothesis under investigation*. In psychological research, this typically amounts to a “white lie” of sorts. The participants are given enough information to evaluate their own risks. For a study on nonconscious mimicry, there are no serious risks so the researcher is likely to tell participants only that they are being asked to engage in a conversation while being videotaped. In medical research situations, however, deception can be much more serious. For example, patients who are being tested with an experimental drug may be randomly chosen to receive a placebo. Importantly, in both cases, the deception is only short-term; once the experiment is over, the participants are informed of the true nature of the study and why deception was necessary. Additionally, if a treatment was found to be effective for the experimental group, it will often be made available to participants in the control group at the end of the experiment. This helps to ensure that anyone who *could* benefit from the study *does* benefit from the study.

Once participants are informed, they must also be able to give consent. Again, meeting this standard is trickier than it sounds. To revisit the mind-control studies, the patients were emotionally vulnerable people seeking help from a noted psychiatrist (Dr. Cameron was the president of both the Canadian and American Psychiatric Associations) at a world-class university. They were not told of the treatments they would receive; in some cases, the patients were not informed that they were part of a study at all! Clearly, informed consent was not provided by these research participants. Based on the ethical issues arising from this and many other disturbing studies, modern psychological (and psychiatric and neurological) research includes the following elements in determining whether full consent is given:

- *Freedom to choose.* Individuals should not be at risk for financial loss, physical harm, or damage to their reputation if they choose not to participate.
- *Equal opportunities.* Volunteers should have choices. For example, if the volunteers are introductory psychology students seeking course credit, they must have non-research alternatives available to them for credit should they choose not to participate in a study.
- *The right to withdraw.* Volunteers should have the right to withdraw from the study, at any time, without penalty. The right to give informed consent stays with the participants throughout the entire study.
- *The right to withhold responses.* Volunteers responding to surveys or interviews should not have to answer any question that they feel uncomfortable answering.

Usually, these criteria are sufficient for ensuring full consent. Sometimes, however, psychologists are interested in participants who cannot give their consent that easily. If researchers are studying children or individuals with mental disabilities, some severe psychiatric disorders, or certain neurological conditions, then a third party must give consent on behalf of the participant. This usually amounts to a parent or next-of-kin and, of course, all the rules of informed consent still apply.

After participating in the research study, participants must undergo a full **debriefing**, *meaning that the researchers should explain the true nature of the study, and especially the nature of and reason for any deception*. Although the debriefing of subjects might sound like some kind of military term, it is actually a very important part of the scientific process. You've already read how it is used when deception (or a placebo) is part of a study. But, even in more straightforward experiments, debriefing is necessary to ensure that the participants understand why their time and effort was necessary. This results in the participants leaving the experiment better-

informed about your topic of study as well as about the many considerations involved in creating a psychology experiment. In short, it helps them become more scientifically literate.

The Right to Anonymity and Confidentiality

Listen to the Audio

A final measure of protection involves anonymity and confidentiality. *Anonymity* means that the data collected during a research study cannot be connected to individual participants. In many cases, volunteers can respond on a survey or through a computer-based experimental task without recording their name. This setup is ideal because it reduces both methodological problems (socially desirable responding) and the social risks to participants. If pure anonymity is not possible—for example, when a researcher must watch the participant perform a task—then confidentiality is a reasonable substitute. *Confidentiality* includes at least two parts. First, researchers cannot share specific data or observations that can be connected with an individual. Second, all records must be kept secure (for example, in a password-protected database or locked filing cabinet) so that identities cannot be revealed unintentionally.

#Psych

Does Logging on to Facebook Equal Informed Consent?

In 2014, a group of social scientists reported the results of a massive experiment conducted on nearly 700 000 Facebook accounts (Kramer et al., 2014). The topic was *emotional contagion*: the tendency for individuals to experience the same emotions, to some degree, as the people around them. But does this happen online? As a data scientist at Facebook,

Adam Kramer had both the technical ability and the company's permission to answer this question with an experiment. Over a one-week period, his team manipulated the emotional content of users' news feeds. For one group, the frequency of emotionally negative news stories and posts from friends were reduced; for another, positive stories were reduced. Finally, there were participants in control conditions that only experienced random changes in posts. The researchers found what they expected: after reduced exposure to negative emotions among friends, users began to produce more positive posts of their own. The reverse was true for the positive condition. Although the researchers considered this experiment a success, many Facebook users, consumer advocates, and media scholars felt that it was a violation of privacy—Facebook never informed the account holders that they were going to be subjects in an experiment. In their paper, Kramer et al. claimed that Facebook's Data Use Policy counted as informed consent. This claim presents a tricky ethical area: Users do grant access to Facebook to collect data on their browsing, posting, and reading habits. But this type of permission is for marketing and product development research —is it really the same as informed consent? Given that users did not explicitly agree to research for *scientific* purposes, and that they know they would be manipulated, many psychologists would say no.

The Welfare of Animals in Research

Listen to the Audio

Many people who have never taken a psychology course view psychology as the study of *human* behaviour, possibly because most psychological research does involve humans. But research with animals is just as important to psychological science for a number of reasons. The simplest and perhaps most obvious is that the study of psychology *does include* the behaviour of animals. However, the most significant reason is that scientists can administer treatments to animals that could never be applied to humans, such as lesioning (damaging) specific areas of the brain in order to examine the resulting behavioural impairments. In addition, genetic research requires species with much shorter lifespans than our own so that several successive generations can be observed. Finally, scientists can manipulate the breeding of laboratory animals to meet the needs of their experimental procedures. Selective breeding allows researchers to study highly similar groups of subjects, which helps control for individual differences based on genetic factors.

These forms of animal-based experimentation have improved our understanding of a number of different areas of behaviour. The research area that has benefited most from the use of animal subjects is the study of different brain-related diseases. This leads to an ethical dilemma, however: Is it ethically acceptable to create disease-like symptoms in animals if it could lead to discoveries that could help thousands—or sometimes millions—of people?

Many psychologists use animals in their research, so ethical codes have been extended to cover many nonhuman species.

Mona Lisa Production/Photo Researchers, Inc./Science Source

Working the Scientific Literacy Model

Animal Models of Disease

Listen to the Audio

MPTP (1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine) was accidentally discovered in 1976 by a 23-year-old chemistry graduate student who was attempting to create MPPP, a synthetic drug that produces morphine-like effects. Three days after injecting himself with what he thought would be a pleasure-inducing drug, he began to show symptoms of Parkinson's disease, including tremors and difficulties initiating movements. Six years later, seven young people in Santa Clara County, California, were diagnosed with Parkinson's disease, which typically develops in older adults. Again, these individuals had injected doses of MPPP that were contaminated with MPTP. Based on these cases, neurologists realized that the compound MPTP could prove useful as a model of Parkinson's disease (Langston et al., 1983). Animals receiving injections of MPTP quickly develop Parkinsonian symptoms; it is therefore possible to use these animals to test possible treatments of this disorder. MPTP is now the toxin most frequently used for animal models of Parkinson's disease (Blesa et al., 2012). This leads to interesting questions, however. Are animal models valid and useful tools for researchers trying to find treatments and cures for diseases? Is this process ethical?

What do we know about animal models of diseases?

MPTP is just one of hundreds of techniques for modelling different diseases. There are animal models for Alzheimer's disease, depression, schizophrenia, autism, stroke, Huntington's disease, epilepsy, and drug addiction, among many others (Nestler & Hyman, 2010; Virdee et al., 2012). Not all diseases or conditions can be modelled in the same way, however. Depending upon the underlying cause of the disorder and the brain areas that are likely involved, there are at least four methods scientists can use to create an animal model. First, if a disease is associated with a specific brain area, researchers could anesthetize an animal and remove or damage that part of its brain. Brain damage could also occur by introducing a toxic substance, as occurred in the MPTP patients. Second, scientists could introduce a substance that increased or decreased the levels of certain brain chemicals known as *neurotransmitters* in the brain (see Module 3.2). Parkinson's disease is caused by a loss of the neurotransmitter dopamine; therefore, a drug that reduced dopamine levels could simulate the symptoms of Parkinson's. Third, researchers could create animal models of certain disorders by altering the environments of the animals. For instance, placing animals in an environment that is physically or socially stressful can cause them to behave similarly to individuals with anxiety disorders (Willner et al., 1987). Four, scientists can manipulate the genetic make-up of animals. While earlier research was limited to selectively breeding animals so that they became more prone to a disease, it is now possible to directly alter the genetic codes of animals so that particular traits and physical structures are altered (Spires-Jones & Knafo, 2012). However, despite the enormous possibilities associated with

animal models, these techniques are only as good as the scientists who use them.

How can science test animal models of diseases?

The primary goal of developing animal models of a neurological condition, such as the MPTP model of Parkinson's disease, is to simulate the characteristics of a disease so that researchers can test possible treatments without harming humans. Although this may sound unethical at first, there is a logic behind the use of animal models. In order to find treatments for a disease, scientists need a very large number of individuals with the disease to use as test subjects. Any given treatment that is currently available to humans underwent testing with thousands—sometimes tens of thousands—of animals in order to test different chemical compounds and doses to ensure that the side effects of the treatment did not outweigh its benefits. There are simply not enough people with some diseases for this type of trial-and-error testing to occur. Any study that could take place would require the cooperation of universities and hospitals around the world. And, if that single attempt did not work, it would be difficult to find patients who had not already been tested to use in subsequent treatment attempts. Therefore, the use of animal models was a product of necessity.

Importantly, animal models are not developed in a random fashion. Instead, each animal model of a disease must have the following characteristics (Dzirasa & Covington III, 2012). First, it must share the same physiological and behavioural features of the disease as appear in humans. An animal model of depression would not be accepted if the animals were energetic and playful; instead, the animals' behaviours must resemble the behaviours of humans with depression. Second, both the animal model and the

“real” disorder must involve similar brain structures; otherwise, researchers would be comparing apples and oranges. Third, the tests used to measure the behaviours must be valid. For depressed humans, laboratory tests often involve questionnaires or computer-based tests; these are obviously not useful research methods when testing rats or mice. Instead, the researcher must use an indirect test to try to tap into the same underlying symptom. For example, one symptom of depression is *anhedonia*, the tendency to get less pleasure out of life than one previously did. To test anhedonia in rats, scientists use a sucrose preference test, a task in which rats have the opportunity to seek out a pleasurable taste (sugar!) if they are motivated to do so. The assumption is that “depressed” rats, just like depressed humans, would be less likely to seek out such stimuli (Cryan et al., 2002).

How can we critically evaluate these models?

The easiest criticism of animal models of disease is that animal brains are not human brains. Human brains are obviously more complex; therefore, how valid is it to assume that treatments that change an animal’s behaviour will benefit humans? And, if this isn’t guaranteed, is it ethical to use animal subjects in this way? A second criticism is that researchers are only beginning to understand the specific brain areas involved with a number of different conditions. Oftentimes, a large number of interacting brain areas are involved with a disorder. So, if we are unclear of the biology involved in the human version of the disease, how accurate can the resulting animal models really be? Additionally, it is fairly easy to test the validity of animal models of neurological diseases that have clear, observable symptoms (e.g., Parkinson’s disease and epilepsy); animals modelling epilepsy will have seizures that you can see. However, models of psychological conditions like depression and schizophrenia

present a greater challenge, as the symptoms are often thought-based and subjective. The rat can't explain what he is seeing or feeling. Instead, the researchers must infer that these mental states are occurring (in one form or another) in the animal subjects being tested. Finally, is an animal with limited cognitive abilities even *capable* of serving as a model for a disorder that involves impairments of higher-order cognitive abilities (Nestler & Hyman, 2010)? For example, how can you tell if a laboratory rat is having a hallucination?

These are all valid criticisms and highlight the importance of meeting the conditions of a good model discussed in the previous section. Our confidence in an animal model will also increase if other lines of research produce similar results. So, if brain-imaging tests in humans find problems in the same brain areas being manipulated in an animal model, that model will become more valid. Through the use of converging operations—using multiple research methods to analyze the same question—it is possible to create effective animal models.

Why is this relevant?

Anyone who has watched an elderly relative become a shadow of his or her former self as a result of a neurological disease such as Alzheimer's or Parkinson's disease can likely understand the usefulness of animal models. It is impossible to perform large-scale research investigating these disorders and their possible treatment without the use of these experiments. Therefore, the animals used in these studies are helping to reduce the suffering of millions of people around the world. Whether you agree that it is appropriate to use animals in this fashion is a personal decision that you will have to make on your own. It is important to note that the researchers who perform this type of research also think about these issues. They certainly don't take their ethical

responsibilities lightly; every university and research hospital has extremely strict requirements for the treatment of laboratory animals and the well-being of all animals is monitored by laboratory technicians and veterinarians. Importantly, all of these activities are closely monitored by the institution's REB.

REBs for Animal-Based Research

Listen to the Audio

Many ethical standards for animal research were developed at the same time as those for human research. In fact, hospitals and universities have established committees responsible for the ethical treatment of animals, which are in some ways similar to REBs that monitor human research. To be sure, there are differences in standards applied to human research and animal research. For example, we obviously do not ask for informed consent from animals. Nevertheless, similar procedures have been put in place to ensure that risk and discomfort are managed in a humane way, and that the pain or stress an animal may experience can be justified by the potential scientific value of the research.

Three main areas of ethical treatment are emphasized by researchers and animal welfare committees. The first is the basic care of laboratory animals—that is, providing appropriate housing, feeding, and sanitation for the species. The second is minimization of any pain or discomfort experienced by the animals. Third, although it is rare for a study to *require* discomfort, when it is necessary, the researchers must ensure that the pain can be justified by the potential benefits of the research. The same standards apply if animals are to be sacrificed for the research.

Ethical Collection, Storage, and Reporting of Data

Listen to the Audio

Ethical research does not end when the volunteers go home. Researchers have continuing commitments to the participants, such as the requirement to maintain the anonymity, confidentiality, and security of the data. Once data are reported in a journal or at a conference, they should be kept for a reasonable amount of time—generally, three to five years is acceptable. The purpose of keeping data for a lengthy period relates to the public nature of good research. Other researchers may request access to the data to reinterpret it, or perhaps examine the data before attempting to replicate the findings. It might seem as though the confidentiality requirement conflicts with the need to make data public, but this is not necessarily true. For example, if the data are anonymous, then none of the participants will be affected if and when the data are shared.

In addition to keeping data safe, scientists must be honest with their data. Some researchers experience great external pressure to obtain certain results. These pressures may relate to receiving tenure at a university; gaining funding from a governmental, industrial, or nonprofit agency; or providing evidence that a product (e.g., a medical treatment for depression) is effective.

Unfortunately, cases of *scientific misconduct* sometimes arise when individuals fabricate or manipulate their data to fit their desired results.

For instance, in 1998, British researcher Andrew Wakefield and his colleagues published a paper in the highly influential medical journal *The Lancet* describing a link between the vaccine for measles, mumps, and rubella and the incidence rate of autism (Wakefield et al., 1998). The response was immediate—many concerned parents stopped having their children vaccinated out of fear that their kids would then develop autism. Panic was increased by sensationalistic media reports of the study as well as by an anti-vaccine media campaign launched by celebrity personality (and, apparently, amateur developmental neurobiologist) Jenny McCarthy. Vaccine rates plummeted; however, autism diagnoses have more than doubled in North America (CDC, 2018). What also changed were the incidence rates of the diseases the vaccines would have prevented. Although measles had officially been eradicated in Canada in 1998 (Public Health Agency of Canada, 2018) and the United States in 2000 (CDC, n.d.), measles has made a significant comeback. Hundreds of preventable cases have occurred—many resulting in hospitalization and deaths—because children were not vaccinated.

Then something interesting happened: Numerous institutions in several countries reported that they were unable to replicate Wakefield's results. As his data received more attention, it became clear that some of it had been manipulated to fit his theory. Additional investigations uncovered the fact that Wakefield planned to develop screening kits to test for stomach problems associated with the vaccine; in other words, he had a financial motivation for creating a controversy related to the vaccine. Luckily, such cases of misconduct seem to be rare and, as occurred in this instance, other scientists are likely to find that the study cannot be replicated in such instances.

The chances of fraudulent data being published can also be decreased by requiring researchers to acknowledge any potential conflicts of interest, which might include personal financial gain from an institution or

company that funded the work. If you look at most published journal articles, you will see a footnote indicating which agency or organization provided the funds for the study. This annotation is not just a goodwill gesture; it also informs the public when there is the *potential* for a company or government agency to influence research. Incidentally, the CIA was not mentioned in any published work resulting from the mind-control studies discussed at the beginning of this module. Dr. Cameron's family destroyed all of his papers upon his death in 1967.

Module 2.3 Summary

Listen to the Audio

2.3a Know . . . the key terminology of research ethics.

Review Module 2.3

Start Over Swap

0/4 REVIEWED · **0** MASTERED

informed consent

Previous Next Got It!

2.3b Understand . . . the importance of reporting and storing data.

Making data public allows scientific peers as well as the general public to have access to the details of research studies. This information includes details about participants, the procedures they experienced, and the

outcome of the study. Furthermore, the requirement that data be stored allows fellow researchers to verify reports as well as to examine the study for any possible misconduct. Fortunately, such cases are rare.

2.3c Understand . . . why animals are often used in scientific research.

First, many research questions that affect medical and public health cannot be answered without animal testing. Second, obvious ethical considerations may not allow such research to be conducted on human subjects. Third, by working with animal models, scientists can control genetic and environmental variables that cannot be controlled with humans.

2.3d Apply . . . the ethical principles of scientific research to examples.

For practice, read the following two scenarios and identify why they may fail to meet ethical standards.

Apply Activity: Is This Ethical?

Try this activity to see how well you can apply these concepts. Read the following descriptions, and determine whether each scenario involves an issue with reliability or validity.

2 questions

1. Dr. Nguyen wants to expose individuals first to a virus that causes people to experience the symptoms of the common cold, and then to varying levels of exercise to test whether exercise either facilitates or inhibits recovery. She is concerned that people may not volunteer if they know they are afraid of the virus, but wants them to know what to expect. She provides detailed information about the virus, typical immune system responses, and the duration of illness that one would expect. She encourages the volunteers to ask questions before signing a statement that they are willing to participate, and then reminds them that they may change their minds at any time.

- ○ Unethical
- ○ Ethical

Next

2.3e Analyze . . . the role of using deception in psychological research.

It is often the case that fully disclosing the purpose of a study before people participate in it would render the results useless. Thus, specific details of the study are not provided during informed consent (although all potential risks are disclosed). When deception of any kind is used, researchers must justify that the benefits of doing so outweigh the costs.

Module 2.4 A Statistical Primer

Listen to the Audio

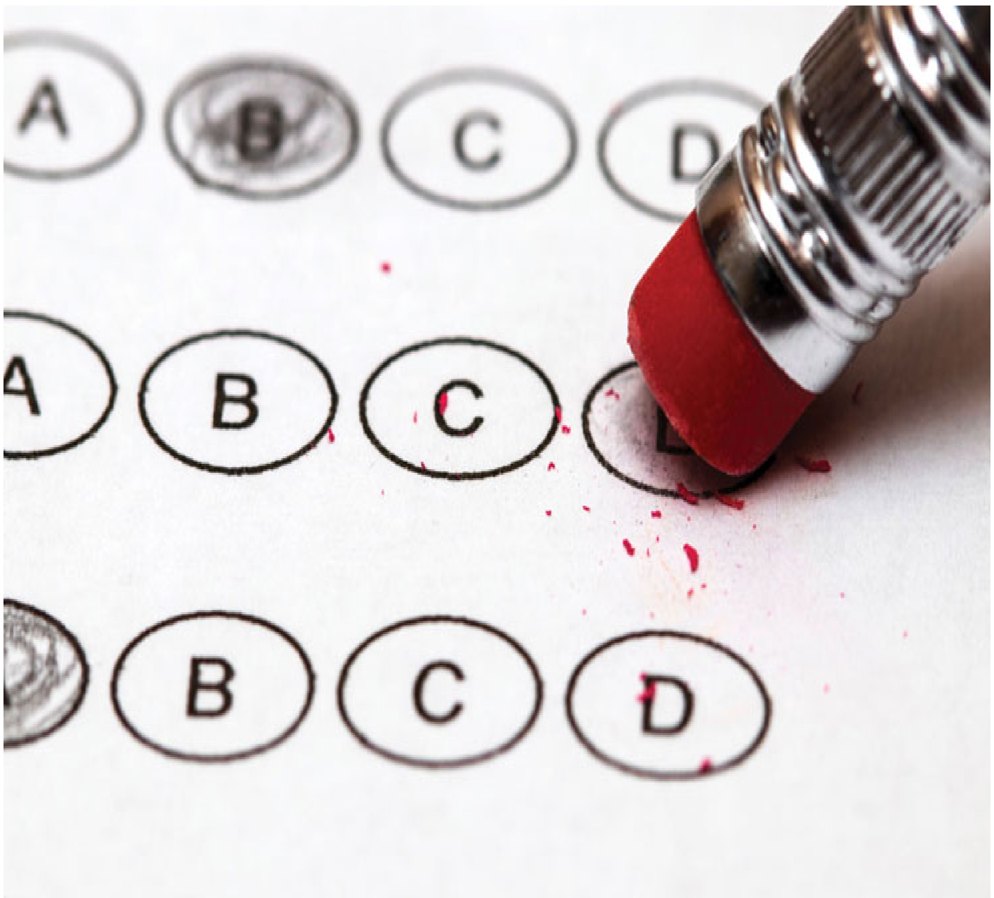


Image Source/Glow Images

Learning Objectives

2.4a Know . . . the key terminology of statistics.

2.4b Understand . . . how and why psychologists use significance tests.

2.4c Apply . . . your knowledge to interpret the most frequently used types of graphs.

2.4d Analyze . . . the choice of central tendency statistics based on the shape of the distribution.

Imagine you are completing a multiple-choice exam when you get stuck on one question. You've recorded your answer as C, but you have this nagging feeling that maybe it should be A. Should you stick with your original answer, or switch? The answer to this question is a judgment of probability: How likely is it that you got it right the first time? The human brain is in many ways a very effective probability machine. However, the way we make predictions is illogical and imperfect. If you are like most students, your intuition will tell you it's probably best to stick with your first choice (75% of students in one survey would agree with you; Kruger et al., 2005). However, over 30 studies on this decision say otherwise; you are much more likely to change from the wrong answer to correct one (Liu et al., 2015). Why is our intuitive sense of probability so far off? It's likely that the emotion associated with switching to the wrong answer is much stronger than the reverse. This, in turn, makes it easier to remember instances in which you switched and got the wrong answer. Because of the emotion and relative ease of remembering examples, people greatly overestimate the chances of being right the first time. This phenomenon, known as the availability heuristic, will be addressed in *Chapter 8**. In this module, however, we'll explore statistics—techniques that allow scientists to use their observations to describe events, test their explanations for psychological phenomena, and make predictions about the future. Certainly we can do all of these things intuitively, but we have to acknowledge that*

heuristics can often lead us astray. With this in mind, we can think of statistics as a set of tools science uses to protect against our imperfect, intuitively statistical brains.

Statistics initially seem scary to a lot of people. But they don't have to be. Statistics can be boiled down to two general steps. First, we need to organize the numbers so that we can get a "big picture" view of the results; this process is helped by the creation of tables or graphs. Second, we want to test to see if any differences between groups or between experimental conditions are meaningful. Once these steps have been completed, it is possible to determine whether the data supported or refuted our hypothesis. In order to keep statistics simple, this module is organized around these two general steps.

Descriptive Statistics

Listen to the Audio

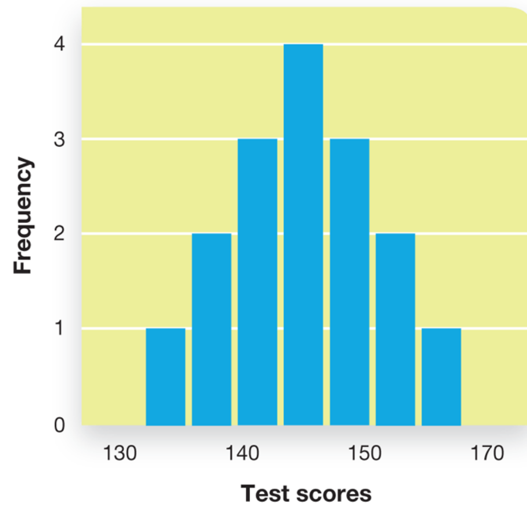
Once research data have been collected, psychologists use **descriptive statistics**, *a set of techniques used to organize, summarize, and interpret data*. This gives you the “big picture” of the results. In most research, the statistics used to describe and understand the data are of three types: *frequency*, *central tendency*, and *variability*.

Frequency

Listen to the Audio

Imagine that you asked a group of students who had just taken the Graduate Record Exam (GRE), a standardized test taken by people who want to go to graduate school, how well they did on the quantitative reasoning section of the exam. Scores can range from 130 to 170, but assuming they were honest, you would likely find the students' scores range from the 140s up to 160s—scores that are closer to average. What you would want to know is (1) whether some scores occurred more often than others and (2) whether all of the scores were clumped in the middle or more evenly spaced across the whole range. These two pieces of information make up the data's *distribution;* the examination of the distribution is a useful first step when analyzing data. Figure 2.7 depicts these data in the form of a *histogram*, a type of *bar graph*. As with most bar graphs, the vertical axis of this graph shows the **frequency**, *the number of observations that fall within a certain category or range of scores*. These graphs are generally very easy to interpret: The higher the bar, the more scores that fall into the specific range. For example, if you look on the horizontal axis in Figure 2.7, you will see a column of test scores corresponding to people who scored around 150 on the test. Looking over to the vertical axis, you will see there were four individuals in that range. It is usually easy to describe the distribution of scores from a histogram. By examining changes in frequency across the horizontal axis—basically by describing the heights of the bars—we can learn something about the variable.

Figure 2.7 Graphing Psychological Data



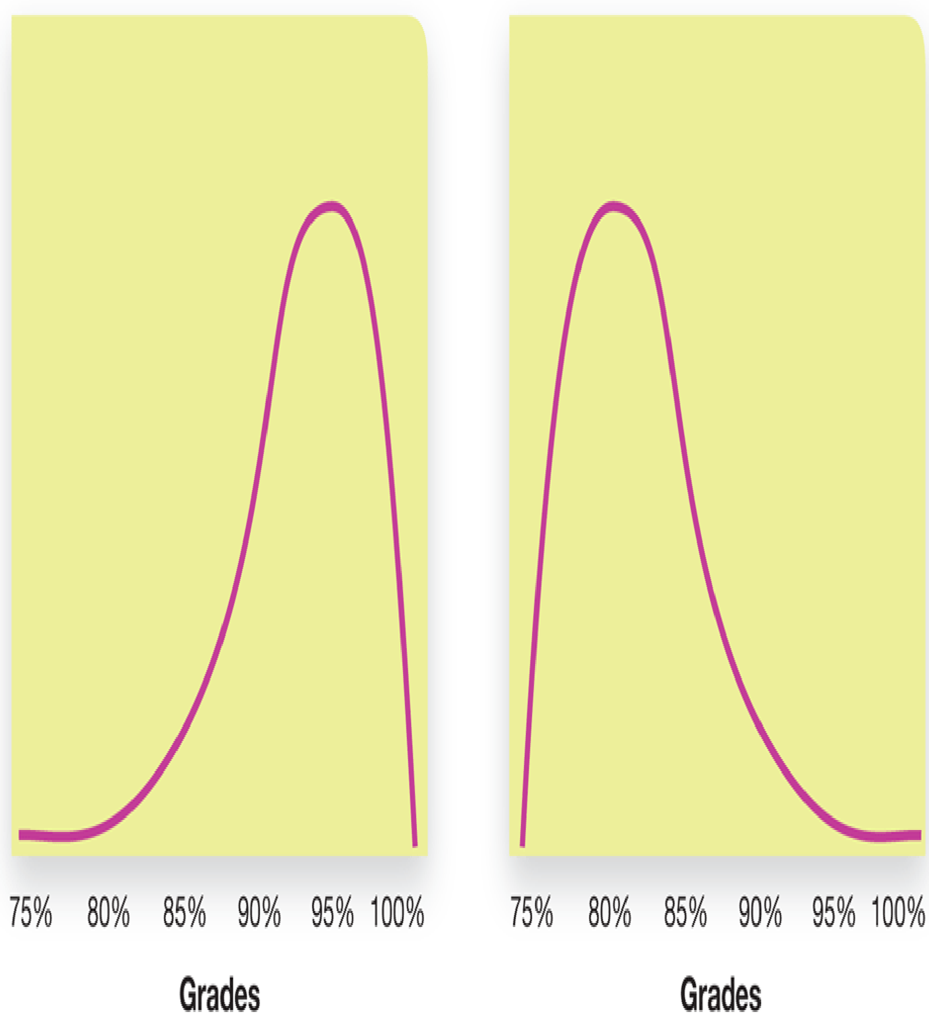
The frequency of standardized test scores forming a normal curve.

Histograms are a nice and simple way to present data and are excellent for providing researchers and students with an initial idea of what the data look like. But they are not the only way to depict results of an experiment. Sometimes it is easier to answer questions about the distribution of the data if we present the same information using a smooth line called a *curve*. Sometimes a distribution is a symmetrical *curve*, as it is with our GRE scores. In this case, the left half is the mirror image of the right half. This is known as a **normal distribution** (sometimes called *the bell curve*), *a symmetrical distribution with values clustered around a central, mean value*.

Many variables wind up in a normal distribution, such as the scores on most standardized tests. Other variables have what is known as a **skewed distribution**, *an asymmetrical distribution with a large cluster of scores on one side and a long "tail" on the other* (Figure 2.8). Imagine a class completes a relatively simple quiz. In this case, you would expect most students to get very high grades with only a few students (probably those who skipped the assigned reading) getting mediocre or poor grades. This would most

likely produce a *negatively skewed* distribution—negative in the sense that the "tail" creating the skew is less than the average. It would be unlikely to find, a *positively skewed* distribution in which the tail extends out above the average.

Figure 2.8 Skewed Distributions



Negatively skewed distributions have an extended tail to the left (as in the left graph above). Positively skewed distributions have an extended tail to the right (as in the right graph above).

Central Tendency

Listen to the Audio

Based on what you have read so far, you have probably noticed that it is useful to look at where the scores seem to cluster together. When we do this, we are estimating **central tendency**, *a measure of the central point of a distribution*. Although we naturally assume that the central tendency is "the average," there are actually three different measures of central tendency used in psychology. The first measure is known as the **mean**, *the arithmetic average of a set of numbers*. This is the measure of central tendency that we are most familiar with as it is used for class averages and in most sports (e.g., batting average in baseball or goals-against average in hockey). A second measure of central tendency is the **median**, *the 50th percentile—the point on the horizontal axis at which 50% of all observations are lower, and 50% of all observations are higher*. The third and final measure of central tendency is the **mode**, *which is the category with the highest frequency (i.e., the category with the most observations)*.

At first glance, it might seem silly to have three different methods of measuring the central tendency of your data. Indeed, when the data are normally distributed as they are in Figure 2.9, the mean, median, and mode are identical. The mean is $30 000, which is exactly in the centre of the histogram. The same can be said for the median; again, it is $30 000, with half of the incomes less than $30 000 and half more than $30 000. Likewise, the mode is the same as the mean and median—$30 000 has the highest frequency, which, as seen in Figure 2.9, is 3. So, if the three measures of central tendency are equal, which do we use? If the data are

normally distributed, researchers generally use the mean. But if the data are skewed in some way, then researchers need to think about which measure is best. The measure used *least* is the mode. Because it provides less information than the mean or the median, the mode is typically only used when dealing with categories of data. For example, when you vote for a candidate, the mode represents the candidate with the most votes, and (in most cases) that person wins.

Figure 2.9 Central Tendency in Symmetrical Distributions

The graph shows that these nine households have the following incomes:

$10 000
$20 000
$20 000
$30 000
$30 000
$30 000
$40 000
$40 000
$50 000

Total = $270 000

Mean income per household:
$270 000 ÷ 9 = $30 000

Median (halfway between the lowest and highest numbers):
$30 000 (10, 20, 20, 30—30—30, 40, 40, 50)

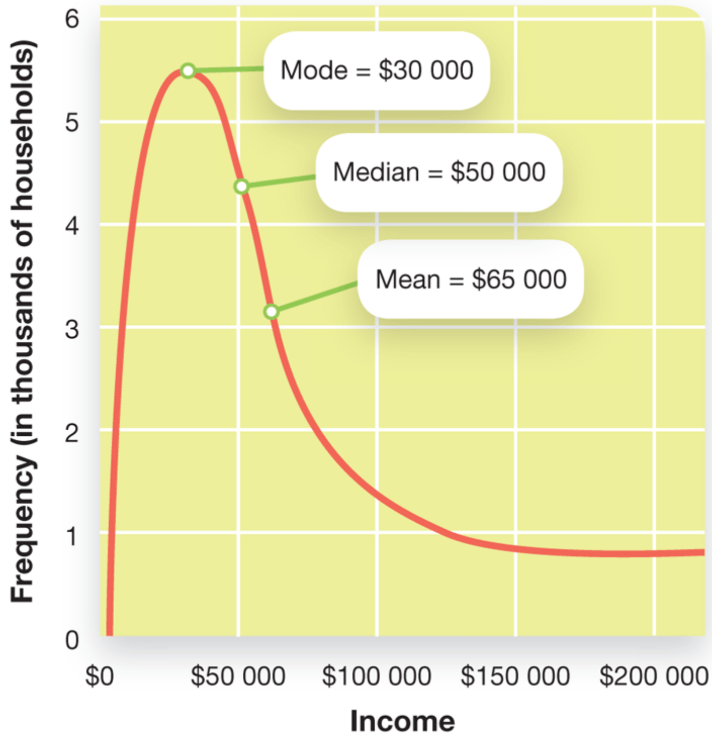
Mode (most frequent number): $30 000

This symmetrical histogram shows the annual income of nine randomly sampled households. Notice that the mean, median, and mode are all in the same spot—this is a characteristic of normal distributions.

When the data are not a perfectly symmetrical curve, the mean, median, and mode produce different values. If the histogram spreads out in one

direction—in Figure 2.10, it is positively skewed—we are usually better off calculating central tendency by using the median. This is because extreme values (positive or negative) will have a large effect on the mean, but will not affect the median. In other words, when you start to add extremely wealthy households to the data set, the tail extends to the right and the mean is pulled in that direction. The longer the tail, the more the mean is pulled away from the centre of the curve. By comparison, the median stays relatively stable, so it is a better choice for describing central tendency when dealing with skewed data. For instance, Amazon.com founder Jeff Bezos is considered by most to be the wealthiest person in the world. He added US$24 billion to his net worth in 2018 (that's $2000 per second) and has an estimated net worth of approximately $135 billion (although his upcoming divorce will cut that number in half).. If you add that figure to the list of nine incomes in Figure 2.10, the mean annual income becomes just over $13.5 billion. If you take the median of those ten incomes, the central tendency is $30 000. Looking at those data, which measure seems most consistent with the "big picture" of the results?

Figure 2.10 Central Tendency in a Skewed Distribution



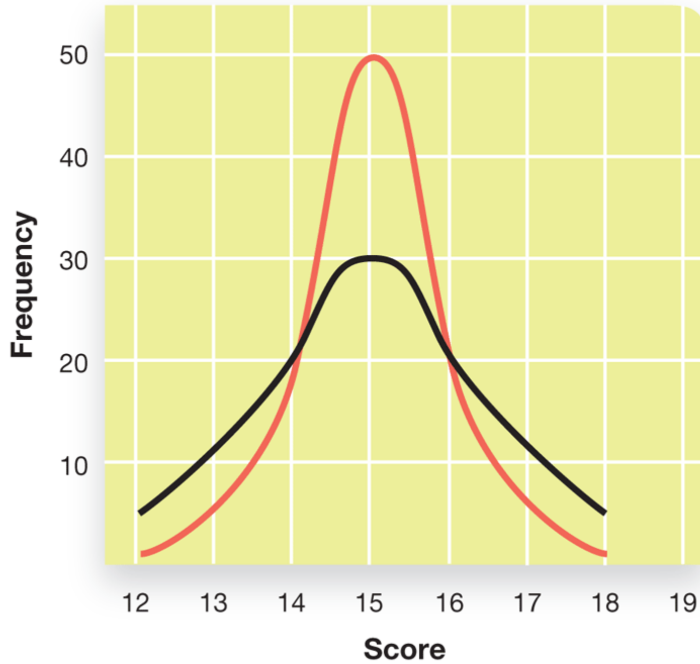
The mean is not always the ideal measure of central tendency. In this example, the mode and the median are actually more indicative of how much money most people make.

Variability

Listen to the Audio

Measures of central tendency help us summarize a group of individual cases with a single number by identifying a cluster of scores. However, this information only tells us part of the story. As you can see in Figure 2.11, scores can differ in terms of their **variability**, *the degree to which scores are dispersed in a distribution*. In other words, some scores are quite spread out while others are more clustered. High variability means that there are a larger number of cases that are closer to the extreme ends of the continuum for that set of data (e.g., a lot of excellent students *and* a lot of poor students in a class). Low variability means that most of the scores are similar (e.g., a class filled with "B" students). Variability can be caused by measurement errors, imperfect measurement tools, differences between participants in the study, or characteristics of participants on that given day (e.g., mood, fatigue levels). All data sets have some variability. But if information about variability is not provided by the researcher, it is impossible to understand how well the measure of central tendency—the single score representing the data—reflects the entire data set. Therefore, whenever psychologists report data from their research, their measures of central tendency are almost always accompanied by measures of variability.

Figure 2.11 Visualizing Variability



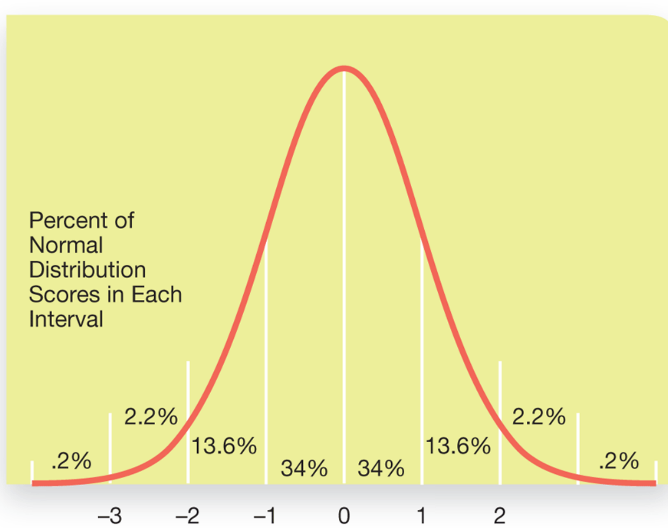
Imagine that these curves show how two classes fared on a 20-point quiz. Both classes averaged scores of 15 points. However, the students in one class (depicted in red) scored much more similarly to one another compared to students in another class (depicted in black), whose scores showed greater variability. The class represented by the black line would have a higher standard deviation.

One calculation that allows researchers to link central tendency and variability is known as the **standard deviation**, *a measure of variability around the mean*. Think of it as an estimate of the *average distance from the mean*. A large standard deviation would indicate that there is a lot of variability in the data and that the values are quite spread out from the mean. A small standard deviation would indicate the opposite.

Standard deviations allow investigators to see how different scores relate to the mean and to each other. Perhaps the best way to understand the standard deviation is by working through an example. In a standard intelligence test, there is a normal distribution (a bell curve) with a mean of 100 and a standard deviation of 15 (see Module 9.1). Based on what

you've read in this module, you would infer that 100 is the mid-point of the curve when these data are graphed. But how much of the data is included in each standard deviation? As you can see in Figure 2.12, researchers have found that approximately 68% of the data are located within one standard deviation of the mean—34% above the mean (between 100 and 115) and 34% below the mean (between 85 and 100). This makes intuitive sense—we would expect a fairly large proportion of the scores to be grouped near the average score. As we move farther away from the average score, each standard deviation would make up less and less of the data, because really high or really low scores are relatively rare. So, the next standard deviation in our example makes up roughly 27% of the data—13.5% of the scores would fall between 70 and 85 and 13.5% would fall between 115 and 130. When you add the two standard deviations together, you can see that they include over 95% of the IQ scores in the population. Therefore, when you hear about people like the physicist Stephen Hawking, whose IQ was estimated to be around 160, you can see that these are rare individuals indeed (comprising less than one-tenth of a percent of the population).

Figure 2.12 Standard Deviations in a Normal Distribution



In a normal curve, most of the data are clustered within one standard deviation of the mean. Over 95% of the data in a normal distribution are found within two standard deviations of the mean.

This section of the module demonstrates that by making a graph and reporting two numbers—the measure of central tendency and the standard deviation—you can provide a "big picture" summary of your data that almost anyone can understand. That's Step 1 of statistics. Step 2 uses these measures to test whether or not your hypothesis is supported by your data—in other words, whether your project worked.

Hypothesis Testing: Evaluating the Outcome of a Study

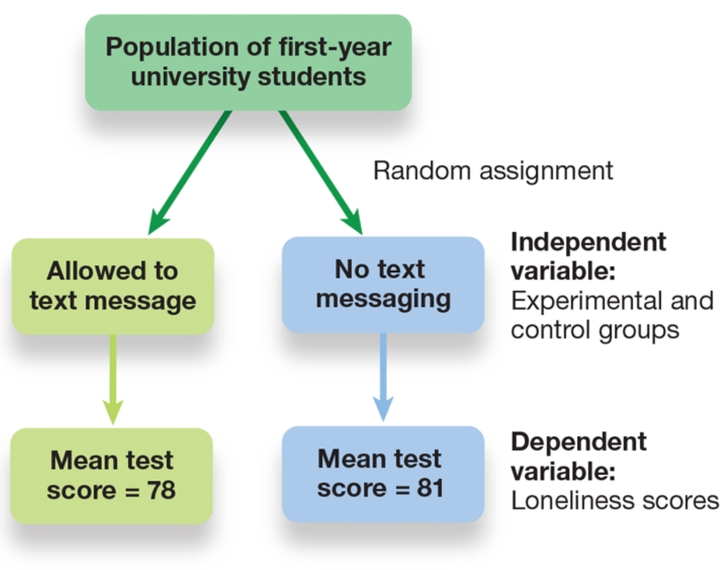
Listen to the Audio

After researchers have described their data, the next step is to test whether the data support their hypothesis. In order to do this, researchers analyze data using a **hypothesis test**—*a statistical method of evaluating whether differences among groups are meaningful (a concept known as a* statistically significant difference*), or could have been arrived at by chance alone*. What scientists are essentially trying to do is determine if their experimental manipulation is the cause of any difference between groups or between conditions. However, the ability to tease out these differences is affected by the concepts discussed earlier in this module—specifically, the measure of central tendency for the groups being measured as well as the variability of data in each of the groups. The difference in the central tendency for the two groups represents a "signal" that we are trying to detect, similar to a voice in a loud room. The variability represents the "noise," the outside forces that are making it difficult to detect the signal.

To make this discussion more concrete, let's use an example of a behaviour that almost everyone performs: texting. Let's say that we wanted to test whether text messaging reduces feelings of loneliness in first-year university students. For three days, randomly selected students who regularly send text messages are assigned to one of two groups: those who can text and those who cannot. After three days, the students fill out a survey measuring how lonely they have felt. The diagram in Figure 2.13 shows us the key elements of such an experiment.

Individuals are sampled from the population and randomly assigned to either the experimental or control group. The independent variable consists of the two groups, which includes texting or no texting. The dependent variable is the outcome—in this case, loneliness (as measured by a valid questionnaire), with larger scores indicating greater loneliness. As you can see, the mean loneliness score of the group who could text message is three points below the mean of the group who did not text message (78 vs. 81, respectively). So, based on this information, are you willing to say that texting causes people to feel less lonely? Or have we left something out?

Figure 2.13 Testing a Simple Hypothesis

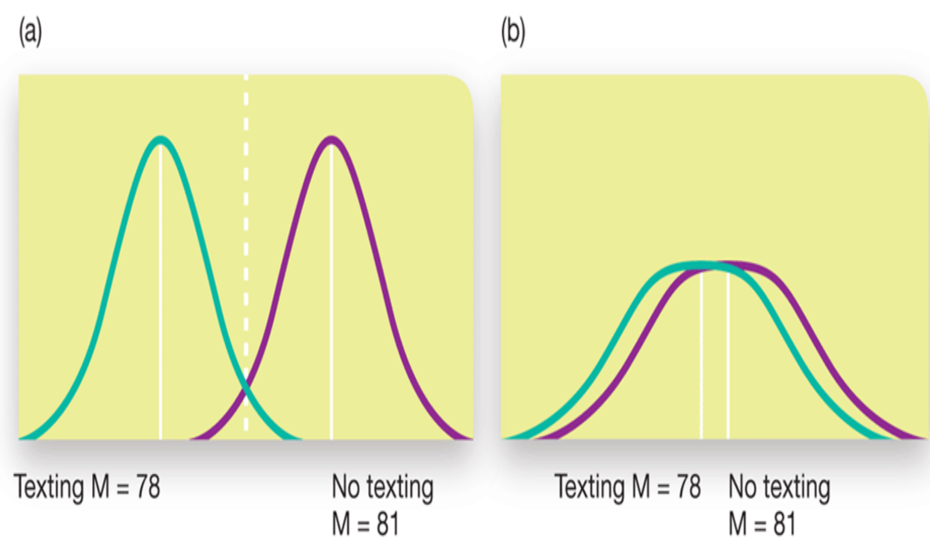


To conduct an experiment on whether texting reduces loneliness, students would be randomly assigned to either text-messaging or no-text-messaging groups. Their average scores on a loneliness scale would then be compared.

What we do not know from the diagram is the variability of test scores. On the one hand, it is quite possible that the scores of the two groups look like the graphs on the left in Figure 2.14. In that situation, the

means are three points apart and the standard deviation is very small, so the curves have very little overlap. In this case, it is fairly easy to detect differences between the groups; the "signal" is easy to pick out from the "noise." On the other hand, the scores of each group could have a broad range and therefore look like the graphs on the right. In that case, the group means are three points apart, but the groups overlap so much—the standard deviations are very high—that they seem virtually identical. In this case, the "noise"—the variability within each of the two groups—is so large that it is difficult to detect the "signal," the differences between the two groups.

Figure 2.14 How Variability Affects Hypothesis Testing



(a) The means (represented by M) differ between the two groups, and there is little overlap in the distribution of scores. When this occurs, the groups are much more likely to be *significantly different*. (b) Even though the means differ, there is much overlap between the distributions of scores. It is unlikely that these two means would be significantly different.

How, then, would researchers know if the difference in scores is meaningful? "Meaningful" seems like a vague term; as we have already discussed, science requires precise definitions. In order to address this

problem, psychologists perform analyses that rely on the concept of *statistical significance*.

A final point is that, although statistical significance tells us that results are meaningful, there is still a possibility that the results were due to chance. It is only through replication—having other laboratories repeat the experiments and produce similar results—that we can become confident that a difference is meaningful. Many scientists now make their stimuli and data available to other researchers in order to encourage this process. This move toward openness and replication is itself quite significant.

Working the Scientific Literacy Model

Statistical Significance

Listen to the Audio

Statistical significance is a concept that implies that *the means of the groups are farther apart than you would expect them to be by random chance alone*. It was first proposed in 1925 by Ronald Fisher, an English statistician working at an agricultural research station east of London (in the U.K.). Statistical significance quickly became a key component of research in many disciplines. However, it has also been a source of some surprisingly intense arguments (Cohen, 1994).

What do we know about statistical significance?

Statistical significance testing is based on the researcher making two hypotheses. The **null hypothesis** *assumes that any differences between groups (or conditions) are due to chance*. The **experimental hypothesis** *assumes that any differences are due to a variable controlled by the experimenter*. The goal of researchers is to find differences between groups that are so large that it is virtually impossible for the null hypothesis to be true; in other words, they are not due to chance. The probability of the results being due to chance is known as a *p-value*. Lower *p*-values (e.g., $p = 0.01$ as opposed to $p = 0.45$) indicate a decreased likelihood that your results were a fluke, and therefore an increased

likelihood that you had a great idea and designed a good experiment.

So, how do we find the *p*-value? The specific formulas used for these calculations will vary according to how the experiment is set up. But they all involve a measure of central tendency (usually the mean) and a measure of variability (usually the standard deviation). These numbers are then used in statistical tests that will produce a *p*-value.

What can science tell us about statistical significance?

When Fisher first presented the idea of significance testing, he noted that scientists needed to establish a fairly conservative threshold for rejecting the null hypothesis (i.e., for deciding that the results were significant). He correctly thought that if it were quite easy for researchers to find a significant result, it would increase the likelihood that results labelled as being significant were actually due to chance. If enough of these false positives occurred, then the entire idea of significance would soon become meaningless. Fisher therefore recommended that researchers use $p < 0.05$ as the cut-off point (this value was consistent with earlier statistical techniques, so his decision was likely an attempt to compromise with other statisticians; Stigler, 2008). If a *p*-value were less than 0.05, then there was less than a 5% chance that the results were due to chance. This *p*-value quickly became the standard in a number of fields, including psychology.

Of course, just because a particular value is widely accepted does not mean that scientists can stop using their critical thinking skills. Sometimes the consequences of having a false positive are quite severe, as in the case of testing new medicines for a disease. It would be tragic to make claims about a wonder drug only to

find out that the results were due to a chance result that could not be reproduced. In such cases, researchers sometimes use an even more conservative *p*-value, such as requiring results to be less than 0.01 (i.e., $p < 0.01$).

It is also worth noting that when testing small sample sizes, it is difficult for the results to reach significance. But some types of research, such as studies of rare brain-damaged patients, have a limited number of potential participants. It therefore becomes more difficult to detect statistically significant differences in these studies despite the fact that the groups do appear to differ when you look at graphs of the data (Bezeau & Graves, 2001). In these cases, significance testing might not be the best statistical tool for analyzing the data. Luckily, significance testing is not the only technique available.

Can we critically evaluate the use of statistical significance testing in research?

Although significance testing has been a potent tool for researchers in the social sciences for almost a century, it does have some detractors. American psychologist Paul Meehl (1967) subtly described significance testing as "a potent but sterile intellectual rake who leaves in his merry path a long train of ravished maidens but no viable scientific offspring" (p. 265). Although this description may be a touch dramatic, there *are* at least two concerns related to significance testing. The first is the problem of multiple comparisons. If a "fluke" result can occur approximately 5% of the time, the more tests you perform for your experiment, the greater the likelihood that one of them is due to chance. In order to cope with this problem, researchers generally use a stricter acceptable *p*-value; as the number of comparisons increases, researchers decrease the *p*-value (i.e., make it more conservative). This makes it more difficult to

produce significant results, but does help ensure that the results are not due to chance. A second problem is the fact that as you increase the number of participants in your study, it becomes easier to find significant effects. At first blush, this doesn't seem like a valid concern. Having more participants means that you are sampling a larger portion of the population of interest. Isn't that a good thing? The answer is yes, of course it is. But if you sample thousands of people—as often happens in medical studies tracking potential lifestyle causes of diseases—extremely small differences will still be statistically significant. The media provides almost daily reports of different foods increasing or decreasing the risk of particular diseases. Before totally altering your lifestyle, it is best to look up the original report to see if the difference was large, or was simply due to the fact that the sample size was in the thousands.

As an alternative to significance testing, Jacob Cohen (1988) developed techniques that shift the attention to a concept he called *effect sizes*. Rather than saying that a difference is statistically significant, which is essentially a yes–no decision, effect sizes tell the researcher whether the difference is statistically small or large. So, instead of an experiment supporting or disproving a theory, effect sizes allow the researcher to adjust how much they believe that their hypothesis is true (Cohen, 1994).

Why is this relevant?

Statistical significance gives psychology researchers a useful standard for deciding if the differences between groups (or experimental conditions) are meaningful. Having established criteria for deciding if an effect is significant is important, because it means that all researchers are using standardized tools. If different research groups were using different criteria for

deciding that effects were “real,” then it would be nearly impossible for that research area to move forward—people would be speaking different languages. Significance testing makes sure that everyone is on the same page, statistically speaking. However, effect sizes are becoming commonplace as most academic journals now require researchers to report *both* statistical significance *and* effect sizes, thus giving readers an even more detailed picture of the data.

Module 2.4 Summary

Listen to the Audio

2.4a Know . . . the key terminology of statistics.

Review Module 2.4

Start Over Swap

0/15 REVIEWED · 0 MASTERED

normal distribution

Previous Next Got It!

2.4b Understand . . . how and why psychologists use significance tests.

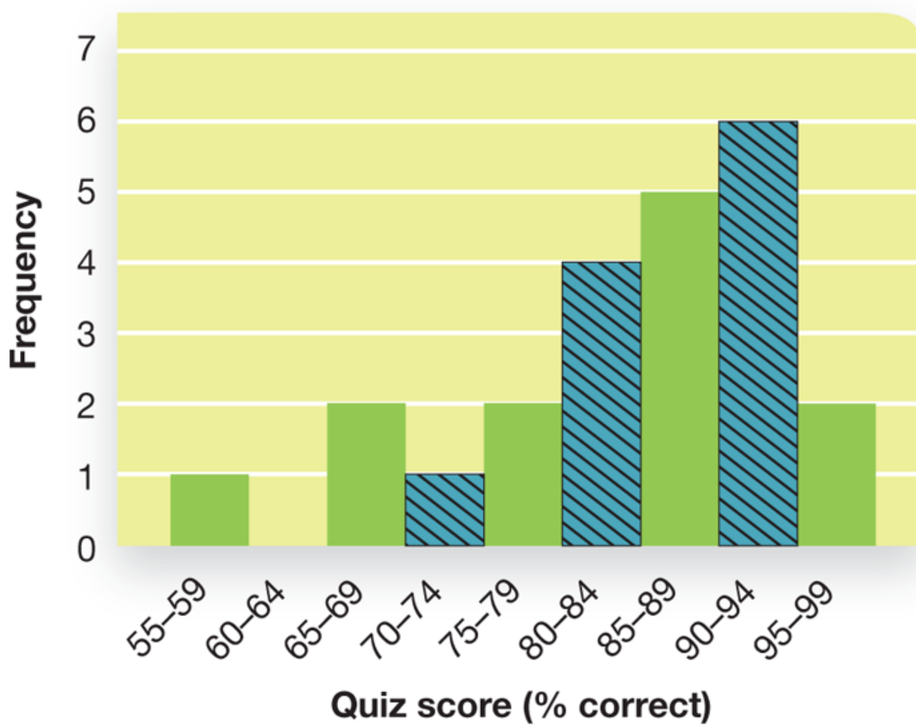
Significance tests are statistics that tell us whether differences between groups or distributions are meaningful. For example, the averages of two groups being compared may be very different. However, how much

variability there is among individuals within each of the groups will determine whether the averages are significantly different. In some cases, the averages of the two groups may be different, yet not statistically different because the groups overlap so much. This possibility explains why psychologists use significance tests—to test whether groups really are different from one another.

2.4c Apply . . . your knowledge to interpret the most frequently used types of graphs.

Take a look at Figure 2.15, a histogram showing the grades from a quiz in a statistics course, and then answer the questions that follow.

Figure 2.15 Apply Activity



Applying Your Knowledge

Figure 2.12a shows the distribution of test scores for a statistics class. Fill in the blanks for each of the questions below to see how well you understand the graph. (For questions two and three, use numerals instead of spelling out the words.)

1. The shape of this distribution of scores is

×

skewed.

2. The mode in this graph is the range between

×

and

×

.

3. The graph indicates that

×

students

earned a B (80 to 89 points).

Create Blank

WORD BANK

Start Over Check Answers

2.4d Analyze . . . the choice of central tendency statistics based on the shape of the distribution.

Although the mean is the most commonly used measure of central tendency, it is not always the best method for describing a set of data. For example, incomes are positively skewed. Suppose one politician claims the mean income level is $40 000, while the other claims that the median income level is $25 000. Which politician is giving the more representative measure? It would seem that the median would be a more representative statistic because it is not overly influenced by extremely high scores.

Chapter 3
Biological Psychology

Listen to the Audio

3.1 Genetic and Evolutionary Perspectives on Behaviour

Heredity and Behaviour

Evolutionary Insights into Human Behaviour

Working the Scientific Literacy Model: Hunters and Gatherers: Men, Women, and Spatial Memory

Module 3.1 Summary

3.2 How the Nervous System Works: Cells and Neurotransmitters

Neural Communication

The Chemical Messengers: Neurotransmitters and Hormones

Working the Scientific Literacy Model: Testosterone and Aggression

Module 3.2 Summary

3.3 Structure and Organization of the Nervous System

Divisions of the Nervous System

The Brain and Its Structures

Working the Scientific Literacy Model: Neuroplasticity and Recovery from Brain Injury

Module 3.3 Summary

3.4 Windows to the Brain: Measuring and Observing Brain Activity

Insights from Brain Damage

Structural and Functional Neuroimaging

Working the Scientific Literacy Model: Functional MRI and Behaviour

Module 3.4 Summary

Module 3.1 Genetic and Evolutionary Perspectives on Behaviour

Listen to the Audio

Vitstudio/Shutterstock

Learning Objectives

3.1a Know . . . the key terminology related to genes, heredity, and evolutionary psychology.

3.1b Understand . . . how twin and adoption studies reveal relationships between genes and behaviour.

3.1c Apply . . . your knowledge of genes and behaviour to hypothesize why a trait might be adaptive.

3.1d Analyze . . . claims that scientists have located a specific gene that controls a single trait or behaviour.

3.1e Analyze . . . explanations for cognitive gender differences that are rooted in genetics.

In November 2018, a Chinese researcher named He Jiankui shocked the scientific world when he announced that he had edited the genes of several human embryos in his laboratory. Each of these embryos were from families in which the father was HIV positive. He and his colleagues altered copies of gene CCR5 in order to increase the embryos' resistance to HIV. Using invitro fertilization, these embryos could then be implanted into the mother and could develop into viable offspring. In fact, He reported, genetically engineered twin girls, named Nana and Lulu, had already been born. The announcement brought immediate and widespread condemnation from politicians and scientists throughout the world (Cohen, 2018; Normille, 2018). The idea of altering the genetic material of human embryos appeared to cross a very important ethical line. Until that time, genetic studies primarily used

simple organisms like fruit flies, with some labs using more complex organisms such as rats. Humans were off-limits. But should they be?

He Jiankui defended his actions, stating that he was acting ethically by improving the lives of children. His genetical manipulations would make them HIV resistant and would therefore prevent the children from experiencing any medical consquences or the stigma associated with HIV and AIDS (Cohen, 2018). However, altering an embryo's genetics is as complicated ethically as it is scientifically. One ethical issue is that we can't predict whether Nana and Lulu will suffer any unexpected side effects from the procedure—side effects that could include being more susceptible to other dangerous illnesses.

He's research leads us to another ethical issue: should gene editing should be used to enhance characteristics such as intelligence, athleticism, or appearance. Would these procedures be available to everyone or just to the very wealthy? As you can see, the world of genetics—the building blocks of our body and brain—is a scientifically and ethically complex one. In this module, we will examine how these genetic building blocks are related to human behaviour.

A question that underlies a great deal of psychological inquiry is "Why do we behave the way we do?" In some situations, you might be tempted to say that your behaviour was a reaction to someone else or to the situation that you were in. In others, you might say that you *interpreted* a situation in a particular way, and that led to a particular response. You might also say that you just reacted "naturally," which implies that your behaviour is sometimes hard-wired. According to the biopsychosocial model of psychology, all three explanations can be valid in some situations. Therefore, to fully understand why you behave the way you do, it is necessary to understand the forces that influence each of these factors that affect our behaviour. In this module, we will focus on genetic and evolutionary explanations; however, it is important to remember that

almost everything you do—or anyone else does—is due to biological, cognitive (psychological), and social factors.

Heredity and Behaviour

Listen to the Audio

Examples of genetic influences on physical traits easily come to mind because we tend to share our eye colour, facial characteristics, stature, and skin colouration with our parents. But research has made it clear that behaviours are also influenced by genes; indeed, the two are often related. Genetics has an influence on the brain, just as it has an influence on eye colour, and changes in brain functions lead to changes in behaviour. Therefore, although a discussion of genetics may seem unrelated to how you think or feel, the work of genes—both during development and during everyday life—has a dramatic effect on your behaviour.

The Genetic Code

Listen to the Audio

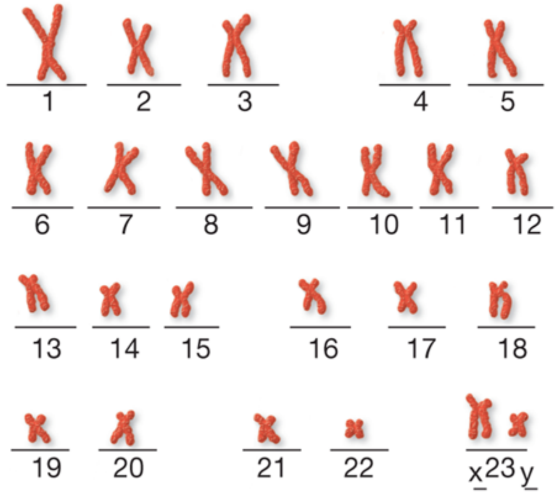
Given that genetics can influence so many aspects of our lives, it is important to review some of this field's basic concepts. Our genetic code isn't hidden in the darkest corners of our brains. Instead, it is found in the nucleus of most of the billions of cells in the human body. This genetic material is organized into **genes**, *the basic units of heredity; genes are responsible for guiding the process of creating the proteins that make up our physical structures and regulate development and physiological processes throughout the lifespan*.

Genes are composed of segments of **DNA (deoxyribonucleic acid)**, *a molecule formed in a double-helix shape that contains four nucleotides: adenine, cytosine, guanine, and thymine* (see Figure 3.1). These nucleotides are typically abbreviated using the first letter of their names—A, C, G, and T. Each gene is a unique combination of these four nucleotides. For example, a gene may consist of sequences of nucleotides such as AGCCTAATCGATGCGCCA . . . and so on. These sequences of nucleotides (i.e., these genes) represent the instructions or code used to create the thousands of proteins found in the human body. These proteins specify which types of molecules to produce and when to produce them. Genes also contain information about which environmental factors might influence whether the genes become active (gene activation is commonly referred to as *expression*). Together, this information makes up an individual's **genotype**, *the genetic makeup of an organism—the unique set of genes that comprise that individual's genetic code*.

The result is an organism's **phenotype**, *the physical traits and behavioural characteristics that show genetic variation, such as eye colour, the shape and size of facial features, intelligence, and even personality*. This phenotype develops because of differences in the nucleotide sequencing of A, C, G, and T, as well as through interactions with the environment.

Although the idea that genes are composed of segments of DNA seems simple enough, we still need to think about how all of our approximately 20 000 to 25 000 genes are organized. All of the cells in our body contain 23 pairs of **chromosomes**, *structures in the cellular nucleus that are lined with all of the genes an individual inherits* (Figure 3.2). Each pair of chromosomes contains one chromosome inherited from the mother and one from the father. Our genes are dispersed across these 23 pairs of chromosomes; so, a gene related to eye colour might be found on one chromosome while genes related to hair colour might be found on a different chromosome. The same genes (e.g., CCR5) are found on *both* the chromosomes inherited from the mother and the chromosomes inherited from the father. However, some genes can have more than one form. For example, a gene might have a long form or a short form. Therefore, it is possible that an individual could inherit two identical versions of a gene (e.g., two short forms) or two different versions (e.g., a short form and a long form).

Figure 3.1, Figure 3.2 Chromosomes and the DNA Molecule



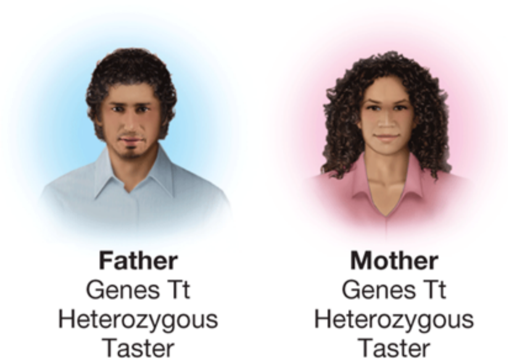
Human Chromosomes Human DNA is aligned along 23 paired chromosomes. Numbers 1–22 are common to both males and females. Chromosome 23 is sex linked, with males having the XY pattern and females the XX pattern.

Source: Lilienfeld, Scott O.; Lynn, Steven J; Namy, Laura L.; Woolf, Nancy J., *Psychology: From Inquiry To Understanding*, 2nd Ed., ©2011. Reprinted And Electronically Reproduced By Permission Of Pearson Education, Inc., New York, NY.

If two corresponding genes at a given location on a pair of chromosomes are the same, they are referred to as **homozygous**. *If two corresponding genes at a given location on a pair of chromosomes differ*, they are **heterozygous**. Whether a trait is expressed depends on which combination of pairs is inherited. In order to make these abstract concepts more concrete, let's look at an example that affects everyone: our sense of taste. Researchers have shown that the ability to taste a very bitter substance called phenylthiocarbamide (PTC) is based on which combination of genes we inherit from either parent (the genotype; see Figure 3.3). The test for whether you can taste PTC (the phenotype) is typically performed by placing a small tab of paper soaked in the substance on the tongue. Some people are "tasters"; they cringe at the bitter taste of PTC. Others—the "non-tasters"—cannot taste anything other than the tab of paper. Those who are tasters inherited at least one copy of the *dominant* gene for

tasting (abbreviated capital "T") from either parent. People can also inherit a *recessive* copy of this gene (t). Those who report tasting PTC are either homozygous dominant (TT) or heterozygous (Tt). Non-tasters are homozygous recessive (tt)—they inherited a recessive copy of the gene from both parents. Those who are tasters may find foods such as Brussels sprouts, cauliflower, and cabbage to be unpleasant, or at least too bitter to eat, as these foods contain PTC.

Figure 3.3 Genetic Inheritance



Whether someone tastes the bitter compound PTC depends on which copies of a certain gene he or she inherits. In this scenario consider the possible outcomes if both parents were heterozygous for tasting PTC and had four children.

1 of 4 Previous Next

Source: Data from Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene by Caspi, A., et al., *Science*, *301*, 386–389. 2003.

In this example, the genotype represents what was inherited (i.e., tt, Tt, or TT). The phenotype represents the physical and behavioural manifestation of that genotype that occurs through interactions with the environment (i.e., being a taster or a non-taster for this *specific* sensation

—note that non-tasters in this context might have normal responses to other tastes). As you will see, this attempt to link genes to behaviour is a rapidly growing area of research in psychology and medicine.

As geneticists continue to unravel different parts of the entire human genome, it is becoming increasingly clear that simple examples like the taster/non-taster trait provide only a glimpse of what knowledge might soon be available to us. Indeed, in recent years, an entirely new field has developed that attempts to identify the genes involved with specific behaviours: behavioural genomics.

Behavioural Genomics: The Molecular Approach

Listen to the Audio

Although researchers have suggested that genetics play a role in many abilities and behaviours, until recently it has not been possible to determine *how* traits are inherited. To make this determination, researchers now go straight to the source of genetic influence—to the genes themselves. **Behavioural genomics** *is the study of DNA and the ways in which specific genes are related to behaviour*. The technology supporting behavioural genomics is relatively new, but once it became available, researchers initiated the **Human Genome Project**, *a massive effort to identify the components of the entire human genome*. This project, which was completed in 2003, resulted in the identification of approximately 22 300 genes, although the exact number is still up for debate (Pertea & Salzburg, 2010). Imagine the undertaking: determining the sequences of the billions of A, C, G, and T nucleotides making up the genes, including where each gene begins and ends, and how they are all arranged on the chromosomes. The Human Genome Project itself did not directly provide a cure for a disease or an understanding of any particular behaviour. Instead, it has led to an abundance of new techniques and information about where genes are located, and it opened the door for an entirely new era of research (Plomin & Crabbe, 2000). Indeed, researchers can now compare the genotypes of different groups of people (e.g., depressed and non-depressed individuals) to look for differences that might shed light on the cause of different conditions. For example, in 1997, researchers identified a gene that was found in families prone to

Parkinson's disease, a neurological disorder involving tremors and difficulties making movements (Polymeropoulos et al., 1997). Since then, a number of genes that are linked to Parkinson's have been identified including *SNCA, PRKN, PINK1, PARK7*, and *LRRK2* (Nuytemans et al., 2010).

However, we must be cautious in our interpretation of such discoveries. Like any approach to answering scientific questions, behavioural genomic research does have its limitations. For example, although a single gene has been identified as a risk factor for Alzheimer's disease, not everyone who inherits it develops the disease. Perhaps it is the combination of multiple genes that leads to Alzheimer's, or that a specific environmental trigger leads to the gene's expression. The same is true for just about all other medical conditions and other characteristics. However, the idea that a single gene causes diseases like Alzheimer's is a common misconception about genes and behaviour.

Myths in Mind

Single Genes and Behaviour

Enter the phrase "scientists find the gene for" into your favourite search engine and you will wind up with more hits than you would ever have time to sift through. Although it is true that behaviour, both normal and abnormal, can be traced to individual genes, typically *combinations* of genes influence behaviour. When it comes to complex characteristics such as personality or disorders like Alzheimer's disease and schizophrenia, there is very little chance that any single gene could be responsible for them (Duan et al., 2010). A person's intelligence and predisposition to alcoholism, anxiety, shyness,

and depression are all examples of traits and conditions with genetic links, but they all involve multiple genes.

Another misconception is that a single gene can affect only one trait. In reality, the discovery that a particular gene predisposes someone to alcoholism does not mean that this gene is *only* relevant to alcohol addiction; it most likely affects other traits as well. For example, genes that are present in people who abuse alcohol are also more likely to be found in individuals who have a history of other problems such as additional forms of drug dependence and antisocial behaviour. In other words, these different behaviours may share some characteristics, and the gene may be related to that "shared genetic liability" (Dick, 2007).

So, when you encounter a headline beginning "Scientists find gene for . . . ," don't read it as "Scientists found THE gene for. . . ." It is likely that the news describes the work of scientists who found another one of the many genes involved in a disorder or, in the case of Alzheimer's disease, a gene that is a risk factor and *not* the sole cause.

Behavioural Genetics: Twin and Adoption Studies

Listen to the Audio

Although behavioural genomics studies can identify genes related to behaviours, they don't tell us how sensitive these genes are to environmental factors like stress, family life, or socioeconomic status. These questions are examined using a complementary field known as **behavioural genetics**, *the study of how genes and the environment influence behaviour*. Behavioural genetic methods applied to humans typically involve comparing people of different levels of relatedness, such as parents and their offspring, siblings, and unrelated individuals, and measuring resemblances for a specific trait of interest. The group that has provided the most insight into the genetic effects on behaviour is twins.

Twins present an amazing opportunity to conduct natural experiments on how genes influence behaviour. One method commonly used in twin studies involves comparing identical and fraternal twins. **Monozygotic twins** *come from a single ovum (egg), which makes them genetically identical (almost 100% genetic similarity)*. An ideal comparison group, **dizygotic twins** (fraternal twins) *come from two separate eggs fertilized by two different sperm cells that share the same womb; these twins have approximately 50% of their genetics in common*. Researchers around the world have studied the genetic and environmental bases of behaviour by comparing monozygotic twins, dizygotic twins, non-twin siblings, and unrelated individuals. The assumption underlying these studies is that if a trait is genetically determined, then individuals with a greater genetic similarity

will also have a greater similarity for that trait. Researchers have also examined these different groups in **longitudinal studies**, *studies that follow the same individuals for many years, often decades*. For example, one twin study determined the degree to which anxiety and depression are influenced by genetics in children and adolescents. It was far more likely for both monozygotic twins to show anxiety or depressive symptoms than for both dizygotic twins to do so; thus, these results demonstrate the influential role that genes play in depression (Boomsma et al., 2005).

Watch Genes, Heritability, and Genetic Concordance

Behavioural geneticists use twin studies to calculate **heritability**—*a statistic, expressed as a number between zero and one, that represents the degree to which genetic differences between individuals contribute to individual differences in a behaviour or trait found in a population*. A heritability of 0 means that genes do not contribute to individual differences in a trait, whereas a heritability of 1.0 indicates that genes account for all individual differences in a trait. It is important to point out that heritability scores do *not* simply reflect how much genetics contributes to the trait itself. Rather, heritability scores tell us the degree to which genetics explain *differences* between people with that trait. So, the heritability of having a tongue is 0

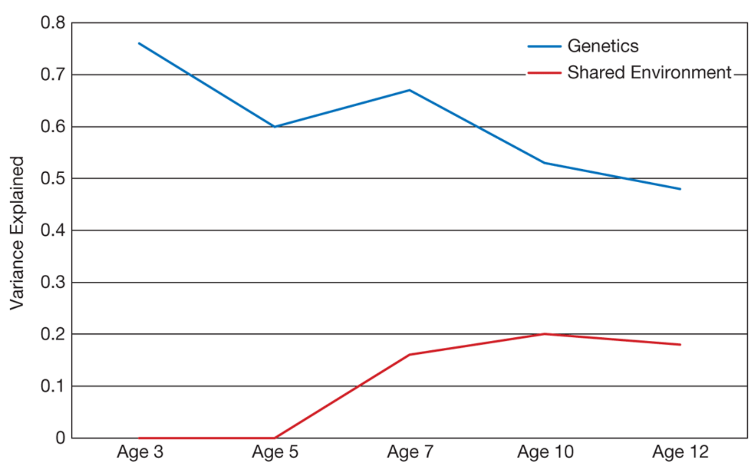
because we all have a tongue (i.e., there are no differences to explain). But the taste sensitivity of that tongue differs based on genetics and on the foods you were exposed to while growing up. Your sensitivity to different tastes will therefore have a heritability score somewhere between 0 and 1.

Identical twins are genetically the same, whereas fraternal twins are no more closely related than full siblings from different pregnancies. However, fraternal twins do share much of the same prenatal and postnatal environment if they are reared together. Researchers assume, then, that if the identical twins are more similar on a given trait than fraternal twins, this difference is due to genetics.

Heritability estimates are rarely, if ever, an extreme value of 0 or 1.0. Instead, genetics and environmental influences (e.g., family life) both

account for some of the differences in our behaviour. For instance, the estimated heritability found in the study on depression and anxiety described earlier was approximately 0.76 for three-year-old identical twin pairs (Boomsma et al., 2005). This tells us that 76% of individual differences in depression and anxiety at age three can be attributed to genetic factors in the population that was studied. However, depression and anxiety can also obviously be influenced by our different life experiences. It should not be a surprise to learn that heritability estimates for these behaviours change as we age. In the Boomsma and colleagues (2005) study, the heritability of anxiety and depression went from 0.76 at age three to 0.48 at age 12 for the identical twin pairs (see Figure 3.4). This change is likely due to the fact that an individual's peer group and social life can have a larger effect on one's emotional well-being during the "tween" and teen-aged years than they would during the toddler years (when family is the main non-genetic factor). This finding should serve as a reminder that the environment never stops interacting with genes.

Figure 3.4 Genetics, Shared Environments, and Depression



Scientists have found that genetics plays a role in depression and anxiety. However, the heritability coefficient for depression and anxiety scores varies with age, ranging from explaining 0.76 to 0.48 of the variance. Interestingly, the impact of the environment also increased from having little to no impact at ages three and seven to accounting for 0.18 of the variance in depression and anxiety scores at age 12.

Behavioural geneticists also study adopted children to estimate genetic contributions to behaviour. The adopted family represents the *nurture* side of the continuum, whereas the biological family represents the *nature* side. On the one hand, if adopted children are more like their biological parents than their adoptive parents on measures of traits such as personality and intelligence, we might conclude that these traits have a strong genetic component. On the other hand, if the children are more like their adoptive, genetically *un*related parents, a strong case can be made that environmental factors outweigh the biological predispositions. Interestingly, young adopted children are more similar to their adoptive parents in intelligence levels than they are to their biological parents. By the time they reach 16 years, however, adopted adolescents score more similarly to their biological parents than their adoptive parents in tests of intelligence, suggesting that some genes related to intelligence do not exert their influence(s) on behaviour until later on in development (Plomin et al., 1997). Compare this finding to that from the study described in the preceding paragraphs: For intelligence, heritability seems to increase with age, whereas the opposite is true for depression and anxiety.

Heritability estimates can vary with age. The heritability of depression and anxiety decreases with age whereas the heritability of intelligence increases with age.

Left: Ale Ventura/PhotoAlto Agency RF Collections/Getty Images; right: SDI Productions/E+/Getty Images

Although heritability estimates provide important information about the different effects of "nature" and "nurture" on different behaviours, we have to be cautious about how we generalize this information. Heritability estimates are limited to the population being studied. We cannot make definitive statements about the heritability of depression in Brazil based on the results of a study conducted in Canada (although we can use the Canadian study to generate hypotheses about what we *think* we would find if we performed the same study in Brazil). This is because any estimate of heritability is affected by (1) the amount of genetic variability within the group being studied and (2) the variability in the environments that members of that group might be exposed to. For example, people from an isolated village in the Amazon rain forest would likely not have much variability in their genetics because they would not have a lot of contact with outside groups. In contrast, many Canadians have diverse genetic backgrounds. Therefore, the individual differences in the Amazon village would most likely be due to environmental factors; this would lead to a lower heritability estimate for this group. This is not to say that one way of life is better than another—but we need to be mindful of these differences in genetic and environmental variability so that we don't incorrectly assume that North American genetic studies generalize to the entire world.

Gene Expression and Behaviour

Listen to the Audio

The fact that heritability estimates change over time based on our different experiences shows us that nature and nurture interact to produce behaviour. What these estimates don't tell us is *how* that interaction occurs in our bodies and brains. Recent advances in our understanding of genetics and the human genome have begun to shed light on some of these relationships.

Almost every cell in our bodies contains the same genes, the basic unit of heredity. But, only some of these genes are active, leading to the production of proteins (or other gene products, such as ribosomal RNA); the other genes are inactive and do not influence protein production. Of the approximately 20 000 to 25 000 genes in the human genome, between 6000 and 7000 are active in the human brain. These genes influence the development of various brain structures, the production of chemicals that allow brain cells to communicate with each other, and the refinement of connections between cells that allow large-scale brain networks to form (French & Pavlidis, 2011). The expression of these genes is influenced by genetics, environmental factors that influence the chemical make-up of the cells, or a combination of the two.

If some genes fail to be activated (or *expressed*) properly, people may be at a greater risk for developing brain-related disorders. For example, Dan Geschwind and colleagues (2011) found that children with autism had less gene expression in several regions of the brain. This decrease in gene

expression was linked to problems with language, decision making, and understanding other people's emotions. Other researchers have investigated the role of gene expression in conditions ranging from addictions (Ajonijebu et al., 2017) to memory (Day & Sweatt, 2011).

Importantly, gene expression is a lifelong process (Champagne, 2010). Factors such as diet, stress level, and sleep can influence whether genes are turned on or off. This study of *changes in gene expression that occur as a result of experience and that do not alter the genetic code* is known as **epigenetics**. Studies with mice have shown that increased maternal licking and grooming (the rodent equivalent of cuddling) led to an increase in the expression of the *GR* gene in the hippocampus (Francis et al., 1999). This gene influences stress responses and can affect how well (or poorly) individuals respond to novel situations. Low levels of licking and grooming led to decreased *GR* expression and a larger stress response (Weaver et al., 2004). Similar effects have been observed in humans. Decreased GR expression was noted in a recent study of childhood abuse victims who later committed suicide, demonstrating the power of these gene–environment interactions. Indeed, there is increasing evidence that epigenetics plays a role in a number of psychological disorders (Labrie et al., 2012).

Epigenetics research suggests that grooming not only influences social bonds, but can also affect the expression of genes.

Eric Isselee/123RF

The fact that gene expression can be influenced by the environment is an example of the *social* part of the *biopsychosocial model* of behaviour discussed throughout this text—nurture can influence nature. Some researchers have speculated that gene expression could also be influenced by the culture in which one lives. Culture, family, and other social bonds all influence how we respond—both psychologically *and* biologically—to a variety of situations and stimuli. Therefore, these sociocultural factors have the potential to influence whether or not certain genes are expressed (Richardson & Boyd, 2005).

Altering Genes and Gene Expression

Listen to the Audio

The advances that genetics researchers have made in the past two decades are stunning. Perhaps the most notable of these discoveries is **CRISPR-Cas9** (often shortened simply to CRISPR and pronounced "crisper"), *a technique that allows genetic material to be removed, added, or altered in specific locations of the genome*. CRISPR was developed after researchers discovered that bacteria can capture sections of DNA from invading viruses. The bacteria use this DNA as a memory aid of sorts, allowing them to recognize the virus if it attacks again. When the virus does attack, the bacteria uses information from the snipped DNA to create an enzyme that cuts apart the virus's DNA, thus disabling it (Hsu et al., 2014).

Scientists can now use CRISPR to study—and to potentially fix—a number of genetic disorders, including the genes related to several diseases that target the brain, such as Parkinson's disease and Alzheimer's disease (Heidenreich & Zhang, 2016). These changes in DNA also influence how genes are expressed. In fact, researchers are now investigating ways to alter gene expression in order to treat various brain disorders. Importantly, this gene editing will be isolated to that individual—the researchers will *not* be manipulating genetic material that would be passed on to future generations.

However, even with this restriction, manipulating genetics is not a simple thing. We know very little about the how altering one set of genes will

affect other genes. For instance, some researchers are concerned that the experiments performed by Dr. He, the Chinese scientist discussed at the beginning of this module, will leave the twin girls whose genes were edited more vulnerable to other disorders, such as West Nile virus (Glass et al., 2006; Hvistendahl, 2018). For now, the public outcry related to Dr. He's work suggests that gene editing in humans will be strictly controlled by governments and scientific organizations. But the temptation to manipulate genes in order to promote specific physical and cognitive traits will likely prove irresistible to some ambitious researcher in the future.

Knowing about genes gives us some idea as to why individuals differ. But genes don't tell the whole story. We also need to examine how some traits or physical characteristics enhanced our ancestors' ability to survive and to pass on these genes to future generations, including us.

Evolutionary Insights into Human Behaviour

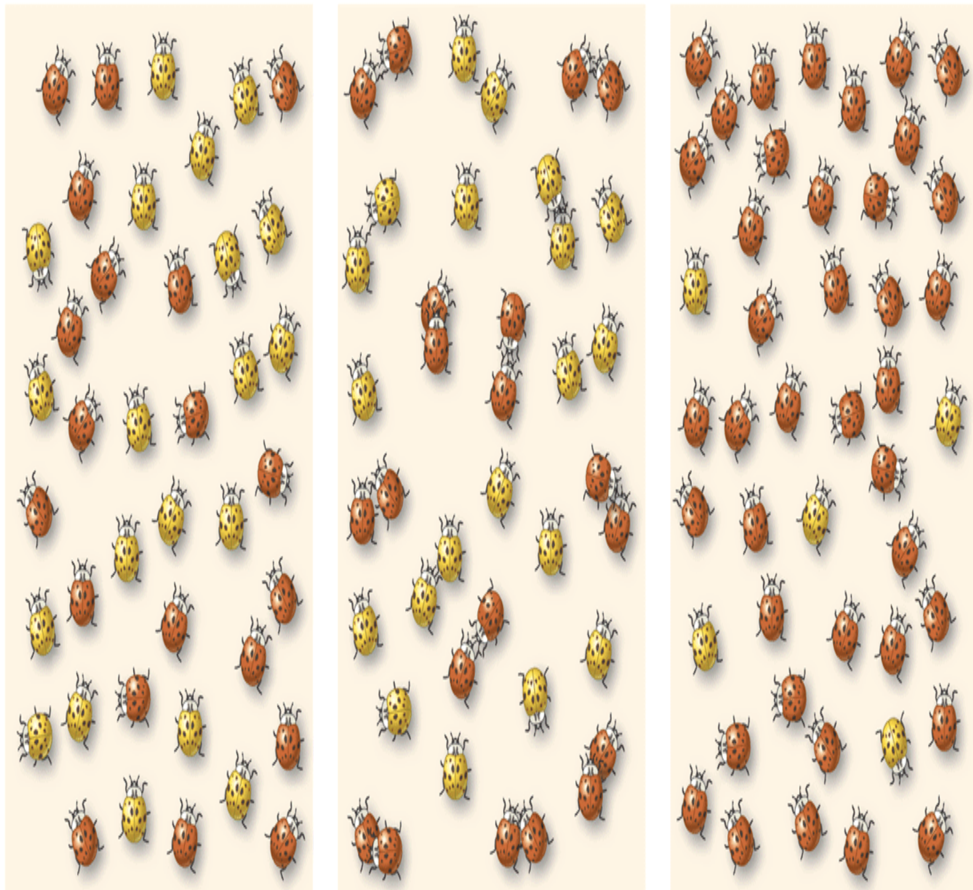
Listen to the Audio

On December 27, 1831, a young Charles Darwin began his voyage on the HMS *Beagle*, a ship tasked to survey the coastline of South America. Darwin's (self-funded) position was to act as a naturalist, examining the wildlife, flora, and geology of the areas the ship visited. This five-year voyage, which included additional stops in Australia and South Africa, exposed Darwin to a vast number of species, and eventually led to him developing one of the most important—and controversial—theories in human history.

While travelling among the Galápagos Islands (900 km west of modern-day Ecuador), Darwin made a number of important observations. First, he identified fossils from several extinct species. This discovery highlighted the fact that not all species were able to survive in this environment. But some species *did* have characteristics that allowed them to flourish. Second, he noticed small differences between the same species of birds and turtles living on different islands. These differences meshed quite well with the particular environments the animals lived in. For example, a species of sea birds whose food supply consisted of crabs that hid along a rocky shore might evolve to have a differently shaped beak than a species of sea birds who had to dive underwater to catch fish. From these observations, Darwin deduced that the species that were a good "fit" for their environment survived while other species did not.

The challenge for Darwin was to find a way to explain this observation. Looking at the individual animals, he saw a number of small differences similar to the differences you'd see between people in your classroom. Some individuals had traits that would enhance their ability to survive, such as speed and strength. These individuals would likely get enough food to eat and would be able to find mates. Individuals without these traits would be less likely to mate. If this pattern continued, there would be more offspring with the favourable traits (strength and speed) than without those characteristics. Darwin developed these observations into his theory of **natural selection**, *the process by which favourable traits become increasingly common in a population of interbreeding individuals, while traits that are unfavourable become less common* (see Figure 3.5).

Figure 3.5 How Traits Evolve



Suppose colouration is a genetically inherited trait in ladybugs.

Suppose a bird that preys on these ladybugs can see the yellow ones better. This brings about a survival and reproductive advantage to red ladybugs that have red-coloured offspring.

Genes for red colouration should spread through the population because natural selection favours red ladybugs over yellow ladybugs.

Evolution through natural selection requires both that a trait be heritable (i.e., be passed down through reproductive means) and that certain individuals within a breeding population have a reproductive advantage for having the trait.

Although genes had not yet been discovered, they lay at the heart of Darwin's theories. When animals mate, each parent provides half of the offspring's genetic material. The genes of some animals would combine in such a way to produce traits favourable to that setting (i.e., they were

adaptive) and the genes of other animals would combine in less useful ways. Because the adaptive or fit animals were more likely to survive and reproduce, these traits—and therefore these genes—would be more likely to be passed on to future generations. This process is known as **evolution**, *the change in the frequency of genes occurring in an interbreeding population over generations*.

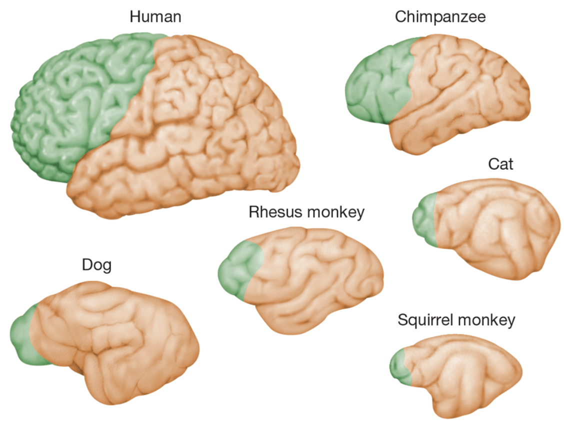
Evolution is not a continuous process, however. If an animal is perfectly adapted for its environment, then there is no evolutionary pressure for change to occur. Let's call that version 1.0 of the animal. But what if some pressure such as a change in the climate or the availability of food occurs? In this case, a given trait might be advantageous in that specific environment and specific point in time. Individuals with that trait would survive; those without it might not. Through natural selection, this trait would eventually become common within that species and may in the future serve other functions and interact with the environment in novel ways. Let's call this version 2.0 of the animal. When the next environmental pressure occurred, a subset of version 2.0 of the animal would possess traits to make them more evolutionarily fit than the other version 2.0 animals. This subset would survive and reproduce, eventually leading to version 3.0 of the animal. While this description is over-simplified, it does illustrate a key point: Any modern species is based upon version after version after version of species that were fit for their particular environment and time.

Evolutionary Psychology

Listen to the Audio

Darwin suggested that humans followed a similar evolutionary path, changing and adapting over the course of thousands of generations. He was correct—there is now fossil evidence showing that many branches of our ancestral family tree died out, likely because their physical and mental characteristics were not fit for their environment. What separated our species, *Homo sapiens*, from other animals was that our ancestors had (1) larger frontal lobes than other species (see Figure 3.6) and (2) had brains with more folds, thus allowing for more brain cells to be squeezed inside their skulls. These adaptations allowed our ancestors to form plans, solve problems, make quick decisions, and control our attention and actions (Stuss, 2011). As a result, they were able to think their way out of different challenges such as changes to the environment or food supply. They also were able to communicate this knowledge using symbolic representations of objects and ideas, as shown in carvings and cave paintings (Chase & Dibble, 1987); this allowed them to pass on knowledge from generation to generation, just as they passed on their genes.

Figure 3.6 The Prefrontal Cortex in Different Species



Human brains have much more space dedicated to the frontal lobes, particularly the prefrontal cortex, than any other species. This brain area is related to many of our higher cognitive functions, such as problem solving and decision making.

Source: Based on Fuster, J. M. (1989). *The Prefrontal Cortex: Anatomy, Physiology, and Neuropsychology of the Frontal Lobe*, 2nd ed. New York: Raven Press.

Although all of this makes intuitive sense to us now, in the second half of the 19th century, Darwin's theories were met with considerable opposition. By stating that animals evolved over time based on environmental pressures, Darwin was challenging the view that animals had been created "as is" by an all-knowing deity. By stating that all humans had common ancestors that evolved into modern people, Darwin was demonstrating that all people—regardless of ethnicity or economic status—were essentially equal. This view was not popular in Victorian England, where the aristocracy looked at the working class with disdain and where the English felt that they had the right to colonize non-Caucasian countries such as India and parts of Africa. However, over time, Darwin's ideas became accepted in almost all scientific circles. Today, a modern branch of psychology known as **evolutionary psychology** *attempts to explain human behaviours based on the beneficial function(s) they may have served in our species' development*.

Natural selection suggests that some traits make an individual more likely to survive and therefore to reproduce. As a result, individuals with superior physical and cognitive traits were able to pass on their genetic material to subsequent generations. These genetic and evolutionary success stories eventually led to the development of the most complex structure known to humanity, and the topic of Modules 3.2 and 3.3: the human brain.

Working the Scientific Literacy Model

Hunters and Gatherers: Men, Women, and Spatial Memory

Listen to the Audio

Evolutionary psychologists are now attempting to link evolutionarily useful behaviours that were performed by our ancestors with our own modern cognitive abilities. One notable area of investigation is the study of differences in male and female cognitive abilities.

What do we know about the sex differences in spatial memory?

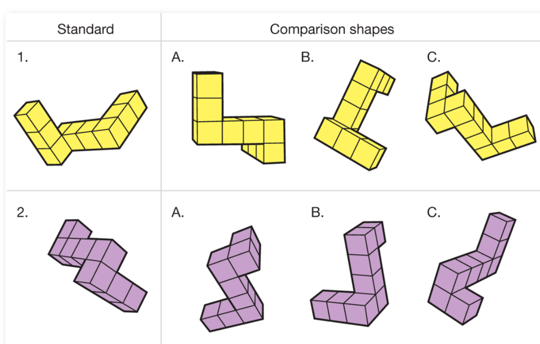
Evolutionary psychologists hypothesize that male and female brains will differ in some ways because males and females have had to solve a different set of problems in order to survive and reproduce. Specifically, due to their size and strength, males were traditionally responsible for tracking and killing animals. These responsibilities would require males to travel over long distances without becoming lost. In other words, males needed to have good spatial skills and the ability to form accurate mental maps. Females, due to the fact that they gave birth and cared for children, were likely unable to go on many of these long-distance hunting expeditions. Instead, they contributed to the group's food supply by foraging for berries and edible plants that were located closer to home. Therefore, females' responsibilities required a good memory for the location of objects (e.g., plants). The

question, then, is whether the abilities that were adaptive for males and females over the course of our species' evolution are still present today (Silverman & Eals, 1992). Put another way, will modern males and females show performance differences on different tests of spatial abilities that are consistent with their historic roles as hunter (males) and gatherer (females)? This is the logic behind the **hunter-gatherer theory**, *which explicitly links performance on specific tasks to the different roles performed by males and females over the course of our evolutionary history*.

How can science test sex differences and spatial memory?

One sex difference that has been reported involves solving the mental rotation task. In this task, participants see a three-dimensional image. They are then shown several additional figures, one of which is a rotated version of the original image. The task is to identify the rotated figure as quickly and as accurately as possible. To make this task more concrete, try the examples shown in Figure 3.7.

Figure 3.7 Mental Rotation Task



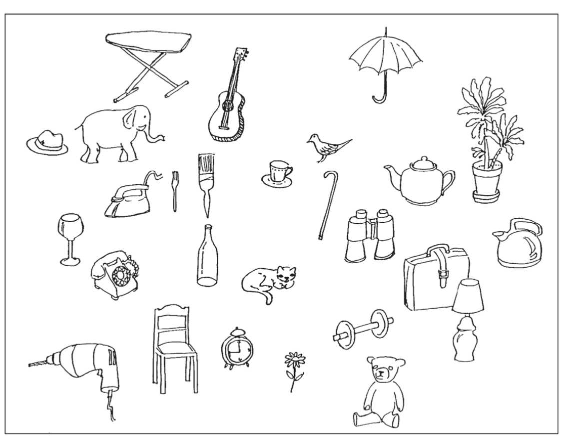
Instructions: Take a close look at standard object #1. One of the three objects to the right of it is the same. Which one matches the standard? Repeat this with standard object #2 and the three comparison shapes to the right of it.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.
Answers: 1. A; 2. B

Research shows that males are generally able to perform this task more quickly than females, and with greater accuracy. A possible reason for this difference is that it is influenced by testosterone levels, which are typically higher in males. In fact, researchers have found that males with high testosterone levels were better at solving the task than males with low levels of testosterone (Hooven et al., 2004). These studies suggests that there is a biological (and possibly evolutionary) explanation for the male advantage in performing this specific task.

Researchers have also found that females outperform males on different types of spatial tasks, specifically, tests involving memory for the spatial *location* of objects (see Figure 3.8). In addition to laboratory-based tests, females outperformed men in experiments conducted in natural settings. In one study, women were able to locate specific plants more quickly than were men and also made fewer mistakes in identifying them (New et al., 2007). This advantage *may* be due to females' evolutionary role as a gatherer rather than as a hunter.

Figure 3.8 Spatial Location Memory Task



In this task, participants are asked to remember the location of specific items.

Source: Republished with permission of Springer Science, from Silverman, I., Choi, J., & Peters, M. (2007). The Hunter-Gatherer Theory of Sex Difference in Spatial Abilities: Data from 40 countries, *Archives of Sexual Behavior, 36(2)*, 261–268; permission conveyed through Copyright Clearance Center, Inc.

Can we critically evaluate this evidence?

Although sex differences on different forms of spatial abilities have been observed in a number of conditions (Voyer et al., 2004), there are some points worth considering. The first is that an overall sex difference does not mean that *all* males will be better at mental-rotation tasks than *all* females. There is a great deal of variability *within* each group on almost all cognitive and perceptual abilities. It is better to think of the sex differences in mental rotation and spatial location tasks in terms of overlapping curves whose average scores differ slightly rather than as one sex being superior to the other on that cognitive ability. A second issue is whether these differences occur across cultures. Although the roles of hunter and gatherer were likely present in most ancient cultures due to females' need to be with young children, there are much greater differences in modern cultures. Some cultures have very strict sex roles that could influence the education and abilities of males and females. Would culture influence the size of the sex differences on tests like the mental-rotation task? As it turns out, the answer is no. The male advantage in the mental-rotation task has been observed in 40 countries, suggesting that the finding is not restricted to Canadian universities (Silverman et al., 2007). However, although these results support the hypothesis that the differences on tasks like the mental-rotation task are biological in origin, they *do not necessarily show* that these differences are due to the evolutionary roles of hunter and gatherer. The differences might

be due to males and females using different strategies on the tasks (Boone & Hegarty, 2017). They might also be due to hormone differences in individuals rather than to sex differences *per se*. Additionally, while evolutionary psychology presents possible explanations, it is more likely that they are only *one of many* factors influencing your behaviour. Remember the biopsychosocial model!

Why is this relevant?

The hunter-gatherer hypothesis shows us that the behaviours of our ancestors might have had an effect on the abilities of modern humans. The physical and cognitive characteristics that made males evolutionarily fit likely differed slightly from the characteristics that benefited females. Males with good spatial skills and females with good location memory would have been more successful than individuals who did not have those abilities. But while males and females differ on some skills, the differences are generally quite small, with many females outperforming males on spatial tasks. Therefore, it is important to be careful about over-interpreting the results of these studies.

Module 3.1 Summary

Listen to the Audio

3.1a Know . . . the key terminology related to genes, heredity, and evolutionary psychology.

Review Module 3.1

Start Over Swap

0/20 REVIEWED · 0 MASTERED

heritability

Previous Next Got It!

3.1b Understand . . . how twin and adoption studies reveal relationships between genes and behaviour.

Both methods measure genetic, environmental, and interactive contributions to behaviour. Twin studies typically compare monozygotic

twins (genetically identical) and dizygotic twins (full siblings sharing the prenatal environment). Adoption studies compare adopted children to their adoptive and biological parents. These designs allow researchers to determine heritability, a number between 0 and 1 that estimates the degree to which individual differences in a trait (in a given population) are due to genetic factors. A heritability of 1.0 would mean that genes contribute to 100% of individual differences. A heritability of 0 would mean that genes have no effect on individual differences. Many human characteristics, including intelligence and personality, have heritability estimates typically ranging between 0.40 and 0.70.

3.1c Apply . . . your knowledge of genes and behaviour to hypothesize why a trait might be adaptive.

Try putting yourself in an evolutionary psychologist's position and answer the following two questions.

Apply Activity

1. What could be an evolutionary reason for the fact that humans tend to add spices to their food?

1 of 2 Reset Next

3.1d Analyze . . . claims that scientists have located a specific gene that controls a single trait or behaviour.

Most psychological traits, as well as disorders such as Alzheimer's disease, involve multiple genes, some of which may not yet have even been discovered. (See the Myths in Mind feature.)

3.1e Analyze . . . explanations for cognitive gender differences that are rooted in genetics.

The Working the Scientific Literacy Model feature summarized research showing that males have an advantage when it comes to a specific mental rotation task. Given that this is a relatively consistent sex difference, high testosterone levels are associated with better performance on the task, and the male advantage has been found cross-culturally, it seems plausible that this difference has a genetic basis. In future chapters we will return to issues related to sex-based differences in cognitive abilities (see Module 9.2).

Module 3.2 How the Nervous System Works: Cells and Neurotransmitters

Listen to the Audio

Rod Williams/Nature Picture Library

Learning Objectives

3.2a Know . . . the key terminology associated with nerve cells, hormones, and their functioning.

3.2b Understand . . . how nerve cells communicate.

3.2c Understand . . . the ways that drugs and other substances affect the brain.

3.2d Understand . . . the roles that hormones play in our behaviour.

3.2e Apply . . . your knowledge of neurotransmitters to understand how they relate to common diseases and psychological disorders.

3.2f Analyze . . . the claim that we are born with all the nerve cells we will ever have.

A bite from an Australian species of snake called the taipan can kill an adult human within 30 minutes. In fact, it is recognized as the most lethally venomous species of snake in the world (50 times more potent than the also fatal venom of the king cobra). The venom of the taipan is neurotoxic, *meaning that it specifically attacks cells of the nervous system. These cells are involved with more than just "thinking"—in fact, networks of nervous system cells working together are critical for basic life functions like breathing and having a heartbeat. A direct attack on these cells, therefore, spells trouble. In the case of the taipan, its bite first leads to drowsiness followed by difficulties controlling the head and neck muscles. Victims then experience progressive difficulty with swallowing, followed by tightness of the chest and paralysis of*

breathing. If enough venom was injected and treatment is not available, coma and death occur. All of this happens because of damage to the cells that will be discussed in this module—cells that work together to produce the complex human behaviours we engage in every day.

Incidentally, not all snake venom attacks the nervous system. The venom found in most rattlesnakes in North America is not neurotoxic (although you still shouldn't hug one). Instead, it damages tissue in the vicinity of the bite as well as those tissues it reaches within the bloodstream, particularly the heart. Although this is not exactly comforting news, it should at least allow you to enjoy nature without being afraid that a snake will attack your nervous system's cells. That's what spiders are for . . .

When we think of cells, we often imagine looking at plants or earthworms through a microscope in high-school biology class. Although thrilling, this activity likely seems to be the furthest thing from the study of behaviour. However, cells—particularly cells in the nervous system—play an incredibly important role in absolutely everything you do, from moving and sensing to thinking and feeling. Understanding how the nervous system's cells function and communicate with each other as part of networks will help you better understand topics discussed in later modules, such as how we learn (Modules 6.1, 6.2, and 7.1), how different drugs (both clinical and recreational) work (Modules 5.3 and 16.3), and how stress affects our bodies and brains (Module 14.2). This module therefore serves as a building block that will deepen your understanding of almost all of the behaviours that make you "you."

Neural Communication

Listen to the Audio

The human body is composed of many types of cells. Psychologists are most interested in **neurons**, *one of the major types of cells found in the nervous system, that are responsible for sending and receiving messages throughout the body*. Billions of these cells receive and transmit messages every day, including while you are asleep. Millions of them are firing as a result of you reading these words. In order to understand how this particular type of cell can produce complex behaviours, it is necessary to take a closer look at the structure and function of the neuron.

The Neuron

Listen to the Audio

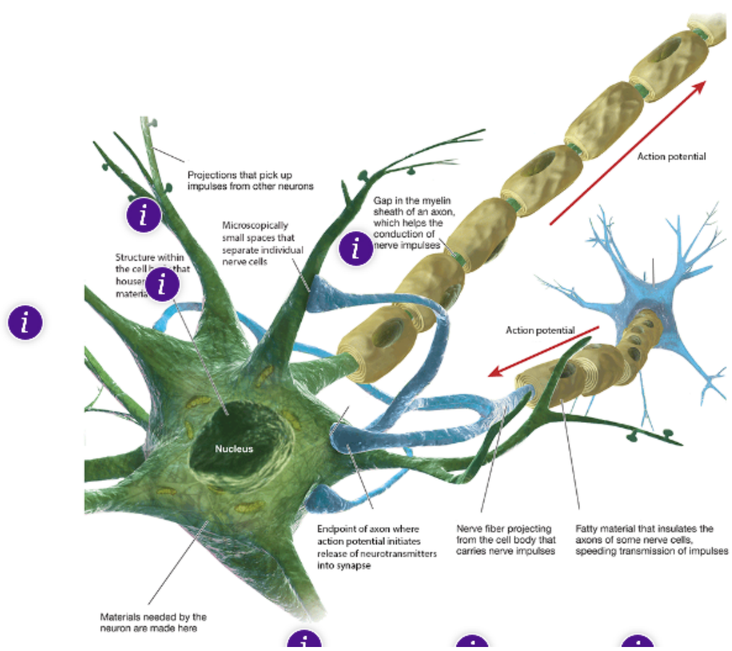
The primary purpose of neurons is to “fire,” to receive input from one group of neurons and to then transmit that information to other neurons. Doing so allows single neurons to work together as part of networks involving thousands (and sometimes millions) of other cells; this will eventually lead to some form of behaviour. To that end, neurons are designed in such a way that there are parts of the cell specialized for receiving incoming information *from* other neurons and parts of the cell specialized for transmitting information *to* other neurons.

Watch The Structure of the Neuron

All neurons have a **cell body** (also known as the *soma*), *the part of a neuron that contains the nucleus that houses the cell's genetic material* (see

Figure 3.9). Genes in the cell body synthesize proteins that form the chemicals and structures that allow the neuron to function. The activity of these genes can be influenced by the input coming from other cells. This input is received by **dendrites**, *small branches radiating from the cell body that receive messages from other cells and transmit those messages toward the rest of the cell*. At any given point in time, a neuron will receive input from several other neurons (sometimes over 1000 other neurons!). These impulses from other cells will travel across the neuron to the base of the cell body known as the *axon hillock*. If the axon hillock receives enough stimulation from other neurons, it will initiate a chemical reaction that will flow down the rest of the neuron.

Figure 3.9 Structures of the Neuron

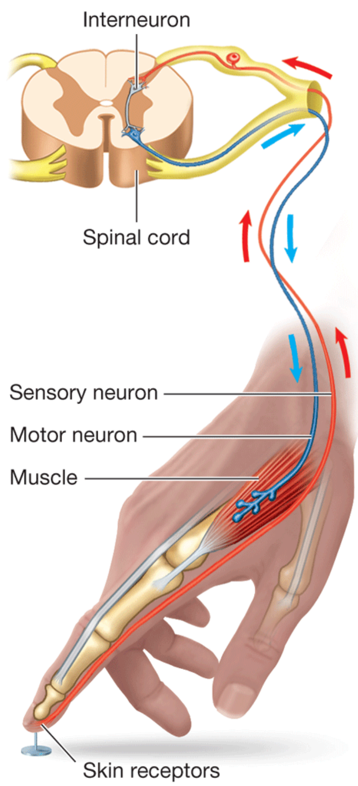


This chemical reaction is the initial step in a neuron communicating with other cells (i.e., influencing whether other cells will fire or not). The activity will travel from the axon hillock along a tail-like structure that protrudes from the cell body. This structure, the **axon**, *transports*

information in the form of electrochemical reactions from the cell body to the end of the neuron. When the activity reaches the end of the axon, it will arrive at **axon terminals**, *bulb-like extensions filled with vesicles* (little bags of molecules). These vesicles contain **neurotransmitters**, *the chemicals that function as messengers allowing neurons to communicate with each other*. The impulse travelling down the axon will stimulate the release of these neurotransmitters, thus allowing neural communication to take place. Many types of neurotransmitters exist, and each can have a number of functions—something we will explore in more detail later in this module.

Although all neurons are designed to transmit information, not all neurons perform the same function. *Sensory neurons* receive information from the bodily senses and bring it toward the brain, often via the spinal cord. In contrast, *motor neurons* carry messages away from the brain and spinal cord and toward muscles in order to control their flexion and extension (see Figure 3.10).

Figure 3.10 Sensory and Motor Neurons



Sensory neurons carry information toward the spinal cord and the brain, whereas motor neurons send messages to muscles of the body. The interneuron links the sensory and motor neurons. This is the pathway of a simple withdrawal response to a painful stimulus.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry To Understanding*, 2nd Ed., ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Within the brain itself, the structure and function of neurons varies considerably. Some cells have few if any dendrites extending from the cell body; these cells do not perform tasks requiring a lot of interactions with other neurons. In contrast, some neurons have huge branches of dendrites. Obviously, these latter neurons will perform functions involving more communication between neurons. The key point is that these differences between neurons are not simply due to chance—they have a purpose. The physical structure of a neuron is related to the function it performs.

Myths in Mind

We Are Born with All the Brain Cells We Will Ever Have

For decades, neuroscience taught us that nerves do not regenerate; in other words, scientists believed that we are born with all the brain cells we will ever have. This conclusion made perfect sense because no one had ever seen new neurons form in adults, and severe neurological damage is often permanent.

In the past 20 years or so, however, advances in brain science have challenged this belief (Wojtowicz, 2012). Researchers have observed **neurogenesis**—*the formation of new neurons*—in a limited number of brain regions, particularly in the hippocampus, a region critical for learning and memory (Eriksson et al., 1998; Cameron & Glover, 2015). The growth of a new cell, including neurons, starts with **stem cells**—*a unique type of cell that does not have a predestined function*. When a stem cell divides, the resulting cells can become part of just about anything—bone, kidney, or brain tissue. The deciding factor seems to be the stem cell's chemical environment (Abematsu et al., 2006).

Initially, scientists thought that adult neurogenesis was a way for the brain to replace old or damaged neurons. However, recent studies indicate that neurogenesis allows the brain to form new pathways, a phenomenon known as *neuroplasticity* (described in greater detail later in this module). Neurogenesis in the hippocampus has been linked to a number of functions including memory, anxiety and stress responses, and the inhibition of behaviours (Christian et al., 2014). Neuroscientists are just beginning to understand the role(s) that neurogenesis plays in these diverse behaviours.

The discovery of neurogenesis has raised some exciting possibilities—perhaps scientists can discover how to trigger the neural growth in other parts of the nervous system. Doing so might allow scientists to repair damaged brain structures or to add cells to brain areas affected by degenerative diseases like Parkinson’s disease and Alzheimer’s disease. When this technology is developed, there may finally be hope for recovery from injury and disease in all nerve cells.

Glial Cells

Listen to the Audio

Although neurons are essential for our ability to sense, move, and think, they cannot function without support from other cells. This support comes from different types of cells collectively known as *glia* (Greek for "glue"). **Glial cells** *are specialized cells of the nervous system that are involved in mounting immune responses in the brain, removing waste, and synchronizing the activity of the billions of neurons that constitute the nervous system*. Given that glial cells perform so many support functions, it should come as no surprise to learn that they outnumber neurons in the brain by a ratio of approximately 10 to 1.

A critical function served by certain glial cells is to insulate the axon of a neuron. These glial cells form a white substance called **myelin**, *a fatty sheath that insulates axons from one another, resulting in increased speed and efficiency of neural communication*. In an unmyelinated axon, the neural impulse decays quickly and needs to be regenerated along the axon; the myelin protects the impulse from this decay, thus reducing how often the impulse needs to be regenerated. The speed difference between axons with and without myelin is substantial. Axons without myelin transmit information at speeds ranging from 0.5 to 10 m/s (metres per second); myelinated axons transmit information at speeds of up to 150 m/s (Hartline & Coleman, 2007; Hursh et al., 1939). For obvious reasons, most neurons in the brain have myelin.

When the myelin sheath is damaged, the efficiency of the axon decreases substantially. This can lead to a number of impairments. For instance, **multiple sclerosis** *is a disease in which the immune system does not recognize myelin and attacks it—a process that can devastate the structural and functional integrity of the nervous system*. When myelin breaks down in multiple sclerosis, it impairs the ability of the affected neurons to transmit information along their axons. As a result, groups of brain structures that normally fire together to produce a behaviour can no longer work as a functional network (Rocca et al., 2010; Shu et al., 2011). It would be similar to trying to drive a car that is missing a wheel. The specific symptoms associated with multiple sclerosis differ depending upon where in the brain the myelin damage occurred. Numbness or tingling sensations could be caused by the disruption of sensory nerve cell signals that should otherwise reach the brain. Problems with voluntary, coordinated movement could be due to the breakdown of myelin that supports motor nerves. The important point is that damage to a small group of axons can lead to impairments in the functioning of large networks of brain areas (Rocca et al., 2012).

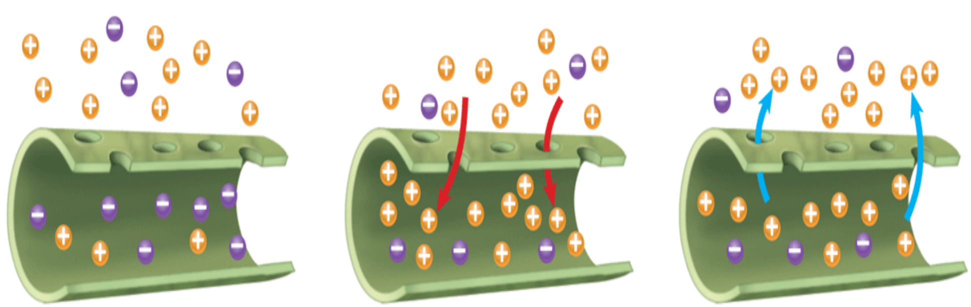
As you can see, each part of an individual neuron and glial cell performs an important function. Ultimately, however, it is the activity of networks of nerve cells that allows messages to be transmitted within the brain and the rest of the body. This activity involves the most important function a neuron can perform: to fire.

The Neuron's Electrical System: Resting and Action Potentials

Listen to the Audio

Neural activity is based on changes in the concentrations of charged atoms called *ions*. When a neuron is not firing, the outside of the neuron has a relatively high concentration of positively charged ions—particularly sodium ions—compared to the inside of the neuron. This difference in charge between the inside and outside of the cell leaves the inside of the axon with a negative charge of approximately −70 millivolts (−70 mV; see the first panel of Figure 3.11). This *relatively stable state during which the cell is not transmitting messages* is known as its **resting potential**.

Figure 3.11 Electrical Charges of the Inner and Outer Regions of Nerve Cells



The inner and outer environments of a nerve cell at rest differ in terms of their electrical charge. During the resting potential, there is a net negative charge. When a nerve cell is stimulated, generating an action potential, positively charged ions rush inside the cell membrane. After the cell has

fired, the positively charged ions are channelled back outside the nerve cell as it returns to a resting state.

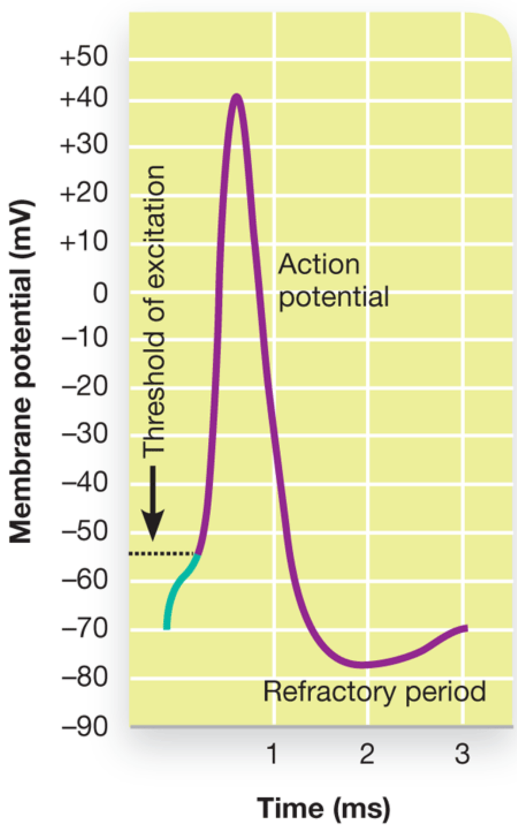
Importantly, this seemingly stable resting state involves a great deal of tension. This is because of two forces: the *electrostatic gradient* and the *concentration gradient*. Don't let these technical terms scare you: the electrostatic gradient just means that the inside and outside of the cell have different charges (negative and positive, respectively), and the concentration gradient just means that different types of ions are more densely packed on one side of the membrane than on the other (e.g., there are more sodium ions outside the cell than inside the cell). However, most substances have a tendency to move from areas of high concentration to areas of low concentration whenever possible; in other words, substances spread out whenever they can so that they are evenly distributed. So, if **ion channels**, *small pores on the neuron's cell membrane*, opened up, there would be a natural tendency for positively charged sodium ions to rush into the cell.

This is what happens when a neuron is stimulated. The surge of positive ions into the cell changes the potential of the neuron (e.g., changing from −70 mV to −68 mV). These charges flow down the dendrites and cross the cell body to the axon hillock, where the cell body meets the axon. If enough positively charged ions reach the axon hillock to push its charge past that cell's firing threshold (e.g., −55 mV), the neuron will then initiate an **action potential**, *a wave of electrical activity that originates at the beginning of the axon near the cell body and rapidly travels down its length* (see the middle panel of Figure 3.11). When an action potential occurs, the charge of that part of the axon changes from approximately −70 mV to approximately +35 mV; in other words, the cell changes from being negatively to positively charged (see Figure 3.12). This change does not

occur along the entire axon at once. Rather, as one part of the axon becomes depolarized, it forces open the ion channels ahead of it, thus causing the action potential to move down the length of the axon as positively charged ions rush through the membrane pores (Hodgkin, 1937). This pattern continues until the action potential reaches the axon terminal.

Figure 3.12

Time Course and Phases of a Nerve Cell Going from a Resting Potential to an Action Potential



Nerve cells fire once the threshold of excitation is reached. During the action potential, positively charged ions rush inside the cell membrane, creating a net positive charge within the cell. Positively charged ions are then forced out of the cell as it returns to its resting potential.

Source: Based on Sternberg, R. J. (2004) The Time Course and Phases of a Nerve Cell Going from Resting to Action Potential, Culture and Intelligence. *American Psychologist*, *59*, 325–338.

Of course, if this were the entire story, then all of our neurons would fire once and never fire again because the ion channels would remain open. Luckily for us, there are mechanisms in place to help our neurons return to their resting state (–70 mV) so that they can fire again. At each point of the axon, the ion channels slam shut as soon as the action potential occurs. The sodium ions that had rushed into the axon are then rapidly pumped back out of the cell, returning it to a resting state. This process of removing the sodium ions from the cell often causes the neuron to become *hyperpolarized;* this means that the cell is more negative than its normal resting potential (e.g., –72 mV instead of –70 mV). This additional negativity makes the cell *less* likely to fire. It normally takes 2–3 milliseconds for the membrane to adjust back to its normal resting potential. This *brief period in which a neuron cannot fire is known as a* **refractory period**.

When the action potential reaches the axon terminal, it triggers the release of that cell's neurotransmitters, a process that allows it to influence the firing of other neurons. This stage of the action potential takes place in the **synapse**, *an area consisting of a neuron's axon terminals and a different neuron's dendrites; these structures are separated by a microscopic space into which neurotransmitters can be released*. The **presynaptic cell** *is the neuron that releases its neurotransmitters into the synapse*. The **postsynaptic cell** *is the neuron that receives neurotransmitters from the presynaptic cell*. The dendrites of the postsynaptic cell contain specialized receptors that are designed to hold specific molecules, including neurotransmitters. Then, this process of neural communication will begin again.

Although this description of an action potential explains how a neuron fires, it does not explain how the nervous system differentiates between a weak and a strong neural response. It would make intuitive sense for a stronger stimulus (e.g., a loud noise) to produce a larger action potential

than a weak stimulus (e.g., someone whispering); however, this is not the case. When stimulated, a given neuron always fires at the same intensity and speed. This activity adheres to the **all-or-none principle**: *Individual nerve cells fire at the same strength every time an action potential occurs*. Neurons do not "sort of" fire, or "overfire"—they just fire. Instead, the strength of a sensation is determined by the *rate* at which nerve cells fire as well as by the number of nerve cells that are stimulated. A stimulus is experienced intensely because a greater number of cells are stimulated, and the firing of each cell occurs repeatedly.

Watch Neurotransmitters

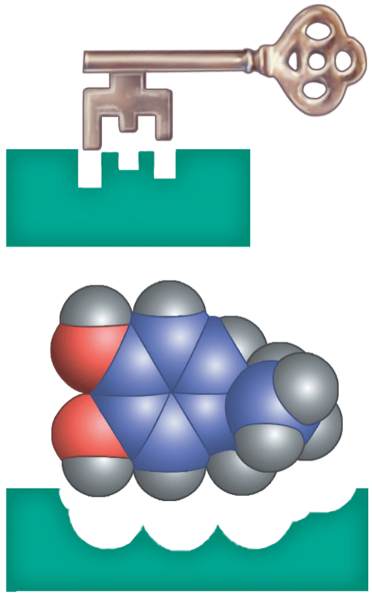
The Chemical Messengers: Neurotransmitters and Hormones

Listen to the Audio

As you read in the first part of this module, the *presynaptic neuron* releases neurotransmitters into the synapse; a fraction of these neurotransmitters will bind to receptors on the *postsynaptic neuron*. This binding can have one of two effects on the postsynaptic cell. If the actions of a neurotransmitter cause the neuron's membrane potential to become less negative (e.g., changing from –70 mV to –68 mV), it is referred to as *excitatory* because it has increased the probability that an action potential will occur in a given period of time. In contrast, if the actions of a neurotransmitter cause the membrane potential to become more negative (e.g., changing from –70 mV to –72 mV), it is referred to as *inhibitory* because it has decreased the likelihood that an action potential will occur. An important factor in determining whether a postsynaptic neuron is excited or inhibited is the type of neurotransmitter(s) binding with its receptors.

Many types of neurotransmitters have been identified, although most neurons send and receive a limited number of these substances. Each neurotransmitter typically has its own unique molecular shape. A lock-and-key analogy is sometimes used to explain how neurotransmitters and their receptors work: When neurotransmitters are released at the axon terminal, they cross the synapse and fit in a particular receptor of the dendrite like a key in a lock (see Figure 3.13).

Figure 3.13 The Lock-and-Key Analogy for Matching of Neurotransmitters and Receptors



The molecular structures of different neurotransmitters must have specific shapes in order to bind with the receptors on a neuron.

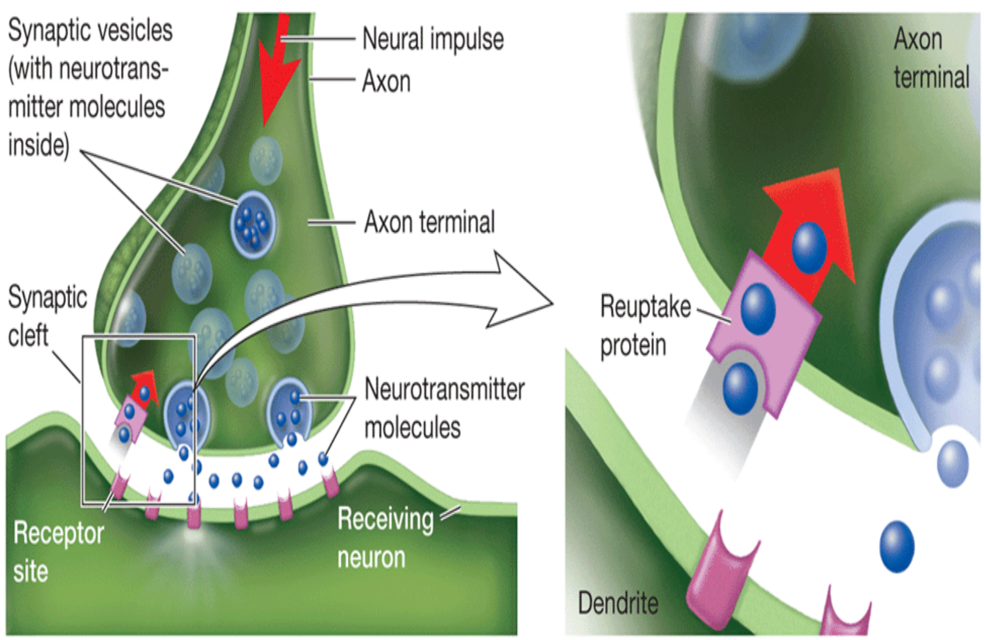
Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, Books A La Carte Edition, 2nd Ed., ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

After neurotransmitter molecules have bound to postsynaptic receptors of a neighbouring cell, they are released back into the **synaptic cleft**, *the minute space between the axon terminal (terminal button) and the dendrite*. This process is almost as important as the action potential itself. Prolonged stimulation of the receptors makes it more difficult for the cell to return to its resting potential; this is obviously necessary for the neuron to be able to fire again. Therefore, if a neurotransmitter remained latched onto a receptor for long periods of time, it would decrease the number of times that the neurons could fire (i.e., it would make your brain less powerful).

Once neurotransmitters have detached from the receptors and float back into the synapse, they are either broken down by enzymes or go through **reuptake**, *a process whereby neurotransmitter molecules that have been*

released into the synapse are reabsorbed into the axon terminals of the presynaptic neuron (see Figure 3.14). Reuptake serves as a sort of natural recycling system for neurotransmitters. It is also a process that is modified by many commonly used drugs. For example, the class of antidepressant drugs known as selective serotonin reuptake inhibitors (SSRIs), not surprisingly, inhibits reuptake of the neurotransmitter serotonin; in this way, SSRIs such as fluoxetine (Prozac) eventually increase the amount of serotonin available at the synapse. The result is a decrease in depression and anxiety (see Module 16.3). The process of reuptake occurs for a number of different neurotransmitters released throughout the nervous system.

Figure 3.14 Major Events at the Synapse



As the action potential reaches the axon terminals, neurotransmitters (packed into spherically shaped vesicles) are released across the synaptic cleft. The neurotransmitters bind to the postsynaptic (receiving) neuron. In the process of reuptake, some neurotransmitters are returned to the presynaptic neuron via reuptake proteins. These neurotransmitters are then repackaged into synaptic vesicles.

Types of Neurotransmitters

Listen to the Audio

There are literally dozens of neurotransmitters influencing the functioning of your brain as you read this module. The various neurotransmitters listed in Table 3.1 are only a small sample of the chemicals that produce your behaviour. Each of these neurotransmitters has a unique molecular structure and is designed to match particular types of receptors, similar to how different keys will fit into different locks. These substances also differ in terms of the specific brain areas they target. As a result, different neurotransmitters will have different effects on our behaviour.

The most common neurotransmitters in the brain are *glutamate* and *GABA*. **Glutamate** *is the most common excitatory neurotransmitter in the brains of vertebrates* (Dingledine et al., 1999; Meldrum, 2000). It is involved in a number of processes, including our ability to form new memories (Bliss & Collingridge, 1993; Peng et al., 2011). Abnormal functioning of glutamate-releasing neurons has also been implicated in a number of brain disorders, including the triggering of seizures in epilepsy (During & Spencer, 1993) and damage caused by strokes (Hazell, 2007; McCulloch et al., 1991). In contrast, **GABA (gamma-amino butyric acid**, for those of you enraged by acronyms) *is the primary inhibitory neurotransmitter of the nervous system, meaning that it prevents neurons from generating action potentials*. It accomplishes this feat by reducing the negative charge of neighbouring neurons even further than their resting state of –70 mV. When GABA binds to receptors, it causes an influx of

negatively charged ions such as chloride to enter the cell, which is the opposite net effect of what happens when a neuron is stimulated. As an inhibitor, GABA facilitates sleep (Tobler et al., 2001) and reduces arousal of the nervous system. Low levels of GABA have been linked to epilepsy, likely because there is an imbalance between inhibitory GABA and excitatory glutamate (Upton, 1994).

Another common neurotransmitter is acetylcholine. **Acetylcholine** *is one of the most widespread neurotransmitters within the body, found at the junctions between nerve cells and skeletal muscles; it is very important for voluntary movement*. Acetylcholine released from neurons connected to the spinal cord binds to receptors on muscles. The change in the electrical properties of the muscle fibres leads to a contraction of that muscle. This link between the nervous system and muscles is known as a *neuromuscular junction*. A number of animals release venom that influences the release of acetylcholine, including the black widow spider (Diaz, 2004) and a number of snakes. Recall the neurotoxic snake venom discussed at the beginning of this module: This toxin disrupts the activity of acetylcholine transmission at the neuromuscular junctions.

In addition to these effects in neuromuscular junctions, acetylcholine activity in the brain is associated with attention and memory (Drachman & Leavitt, 1974; Himmelheber et al., 2000). Altered levels of this neurotransmitter have also been linked to cognitive deficits associated with aging and Alzheimer's disease (Bartus et al., 1982; Craig et al., 2011). Indeed, several drugs used to reduce the progression of Alzheimer's disease are designed to slow the removal of acetylcholine from the synapse, thus allowing it to have a larger effect on postsynaptic cells (Darvesh et al., 2003). The fact that acetylcholine can influence functions ranging from movement to memory shows us that *where* in the nervous system a neurotransmitter is released can have a dramatic influence on *what* roles that neurotransmitter will serve.

This point is particularly noticeable when one discusses a class of neurotransmitters known as the *monoamines*. This group of brain chemicals includes the well-known neurotransmitters dopamine, norepinephrine, and serotonin. **Dopamine** *is a monoamine neurotransmitter involved in such varied functions as mood, control of voluntary movement, and processing of rewarding experiences*. When reading this definition, you can't help but be stunned by the variety of processes influenced by dopamine. This breadth is due to the fact that dopamine is released by neurons in (at least) three pathways extending to different parts of the brain, including areas in the centre of the brain related to movement and to reward responses (Koob & Volkow, 2010; Martinez & Narendren, 2010; see Module 5.3) and areas in the front third of the brain involved with controlling our attention (Robbins, 2000).

Attention is also influenced by our overall alertness or arousal, a characteristic that is affected by the neurotransmitter norepinephrine. **Norepinephrine** (also known as *noradrenaline*) *is a monoamine synthesized from dopamine molecules that is involved in regulating stress responses, including increasing arousal, attention, and heart rate*. Norepinephrine is formed in specialized nuclei in the bottom of the brain (known as the *brainstem*) and projects throughout the rest of the brain, influencing the activity of a number of systems ranging from wakefulness to attention (Berridge & Waterhouse, 2003). It also projects down the spinal cord and serves as part of the "fight-or-flight" response to threatening stimuli. Norepinephrine often works alongside **epinephrine** (also known as *adrenaline*), *a hormone and neurotransmitter created in the adrenal gland on the kidneys*. Both norepinephrine and epinephrine energize individuals to help them become more engaged with a given activity. (Interesting trivia: Epinephrine has its name because the name *adrenaline* was trademarked by a drug company.)

Finally, **serotonin** *is a monoamine involved in regulating mood, sleep, aggression, and appetite* (Cappadocia et al., 2009; Young & Leyton, 2002). It is formed in the brainstem and projects throughout the brain and spinal cord. Serotonin is the neurotransmitter that you are most likely to have heard of due to its critical role in depression. As discussed earlier in this module, many antidepressant medications block the reuptake of serotonin, thus ensuring that this substance remains in the synapse for longer durations. The result is an elevation of mood and a decrease in symptoms of depression and anxiety.

Throughout this section, we have noted that medications (or other substances) can influence the levels of these neurotransmitters as well as how efficiently they bind to their targets. But, as you will see, not all drugs affect neurotransmission in the same way.

Table 3.1 Neurotransmitters and their Functions

After reviewing the names and functions of the different neurotransmitters, test your knowledge by selecting Check Your Understanding.

Neurotransmitter	Function
Acetylcholine	Movement; attention
Dopamine	Control of movement; reward-seeking behaviour; cognition and attention
Norepinephrine	Emotional arousal; attention to new and important stimuli
Serotonin	Regulation of sleep, appetite, mood
Glutamate	Excites nervous system; memory and autonomic nervous system reactions
GABA (gamma-amino butyric acid)	Inhibits brain activity; lowers arousal, anxiety, and excitation; facilitates sleep

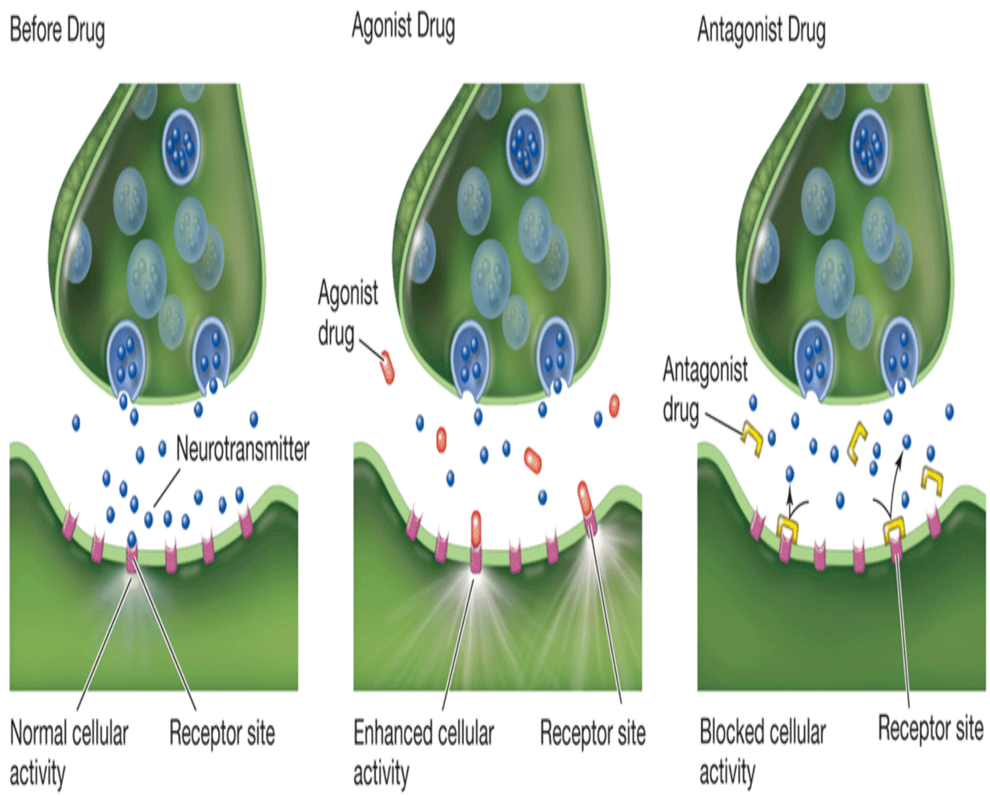
Check Your Understanding

Drug Effects on Neurotransmission

Listen to the Audio

Drugs of all varieties, from prescription to recreational, affect the chemical signalling that takes place between nerve cells. **Agonists** *are drugs that enhance or mimic the effects of a neurotransmitter's action* (see Figure 3.15). The well-known drug nicotine is an acetylcholine agonist, meaning that it stimulates the receptor sites for this neurotransmitter. The antianxiety drug alprazolam (Xanax) is a GABA agonist—it causes relaxation by increasing the activity of this inhibitory neurotransmitter. Drugs can behave as agonists either directly or indirectly. A drug that behaves as a *direct agonist* physically binds to that neurotransmitter's receptors at the postsynaptic cells (e.g., nicotine molecules attach themselves to receptors that acetylcholine molecules would normally stimulate). A drug that acts as an *indirect agonist* facilitates the effects of a neurotransmitter, but does not physically bind to the same part of the receptor as the neurotransmitter. For example, a drug that blocks the process of reuptake would be an indirect agonist. A drug that attaches to another binding site on a receptor but does not interfere with the neurotransmitter's binding would also be an indirect agonist.

Figure 3.15 Drug Effects at the Synapses



Drugs can act as agonists by facilitating the effects of a neurotransmitter, or as antagonists by blocking these effects.

Drugs classified as **antagonists** *inhibit neurotransmitter activity by blocking receptors or preventing synthesis of a neurotransmitter*. You may have heard of the cosmetic medical procedure known as a Botox injection. Botox, which is derived from the nerve-paralyzing bacterium that causes botulism, blocks the action of acetylcholine by binding to its postsynaptic receptor sites (Dastoor et al., 2007). Blocking acetylcholine could lead to paralysis of the heart and lungs; however, when very small amounts are injected into tissue around the eyes, the antagonist simply paralyzes the muscles that lead to wrinkles. When muscles are not used, they cannot stretch the skin—hence the reduction in wrinkling when acetylcholine activity is blocked. Because Botox directly binds with acetylcholine receptors and thus prevents acetylcholine from doing so, it is considered a *direct antagonist*. If a chemical reduces the influence of a

neurotransmitter *without* physically blocking the receptor, it would be classified as an *indirect antagonist*.

Botox injections paralyze muscles, which can increase youthful appearance in areas such as the face. It is a direct antagonist for acetylcholine.

Thinkstock/Stockbyte/Getty Images

Review Applying the Concepts of Drug Agonists and Antagonists

Study the descriptions of events occurring at the synapses between nerve cells and whether the drug involved is an agonist or antagonist. Then select Check Your Understanding to test yourself.

	Type of Drug
A drug binds to the presynaptic cell membrane and prevents dopamine from entering, leaving extra dopamine in the synapse to bind with the postsynaptic cell.	agonist
A drug that affects the cell nucleus and prevents the synthesis (building) of new norepinephrine neurotransmitters.	antagonist
A drug that mimics the effects of glutamate and therefore increases stimulation of postsynaptic cells that glutamate neurotransmitters bind to.	agonist
A drug that prevents the reuptake of serotonin into the presynaptic cell.	agonist
A drug that blocks the release of GABA from presynaptic terminals.	antagonist

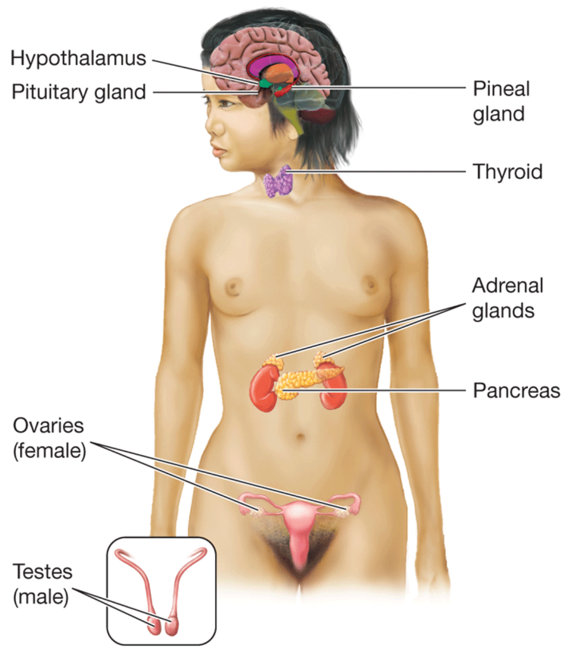
Check Your Understanding

Hormones and the Endocrine System

Listen to the Audio

Neurotransmitters are not the body's only chemical messenger system. **Hormones** *are chemicals secreted by the glands of the endocrine system*. Generally, neurotransmitters work almost immediately within the microscopic space of the synapse, whereas hormones are secreted into the bloodstream and travel throughout the body. Thus, the effects of hormones are much slower than those of neurotransmitters. With help from the nervous system, the endocrine system contributes to *homeostasis*—the balance of energy, metabolism, body temperature, and other basic functions that keeps the body working properly (see Figure 3.16; see Module 11.1). In other words, the brain triggers activity in the endocrine system that then influences the brain's activity via hormones. This cycle continues as our brain and body attempt to maintain the appropriate energy levels for dealing with the environment.

Figure 3.16 The Endocrine System



Glands throughout the body release and exchange hormones. The hypothalamus interacts with the endocrine system to regulate hormonal processes.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed., ©2011. Reprinted And Electronically Reproduced By Permission Of Pearson Education, Inc., New York, NY.

The brain area that is critical for this brain-endocrine relationship is the **hypothalamus**, *a brain structure that regulates basic biological needs and motivational systems*. The hypothalamus releases specialized chemicals called *releasing factors* that stimulate the **pituitary gland**—*the master gland of the endocrine system that produces hormones and sends commands about hormone production to the other glands of the endocrine system*. These hormones can be released by glands throughout the body before finding their way to the brain via the bloodstream.

How we respond to stress illustrates nicely how the nervous and endocrine systems influence each other. In psychological terms, stress is loosely defined as an imbalance between perceived demands and the perceived resources available to meet those demands. Such an imbalance

might occur if you suddenly realize your midterm exam is tomorrow at 8:00 AM. Your resources—time and energy—may not be enough to meet the demand of succeeding on the exam. The hypothalamus, however, sets chemical events in motion that physically prepare the body for stress. It signals the pituitary gland to release a hormone into the bloodstream that in turn stimulates the **adrenal glands**, *a pair of endocrine glands located adjacent to the kidneys that release stress hormones, such as cortisol and epinephrine*. Cortisol and epinephrine help mobilize the body during stress, thus providing enough energy for you to deal with the sudden increase in activity necessary to respond to the stress-inducing situation (see Module 14.2).

Another important chemical is **endorphin**, *a hormone produced by the pituitary gland and the hypothalamus that functions to reduce pain and induce feelings of pleasure*. Endorphins are released into the bloodstream during events such as strenuous exercise, sexual activity, or injury. They act on portions of the brain that are attuned to reward, reinforcement, and pleasure, inhibiting the perception of pain and increasing feelings of euphoria (extreme pleasantness and relaxation). Morphine—a drug derived from the poppy plant—binds to endorphin receptors (the term *endorphin* translates to *endogenous [internal] morphine*). Morphine molecules fit into the same receptor sites as endorphins and, therefore, produce the same painkilling and euphoric effects.

Extracts from the seeds of some poppy flowers contain opium. Morphine and one of its derivatives, heroin, can be synthesized from these seeds.

Martin Nemec/Shutterstock

The final hormone that will be discussed is perhaps the best known. **Testosterone** *is a hormone that serves multiple functions, including driving physical and sexual development over the long term*. Testosterone levels also surge during sexual activity. However, as you will read in the next section, these are not testosterone's only functions.

Working the Scientific Literacy Model

Testosterone and Aggression

Listen to the Audio

Testosterone is one of the main sex hormones produced by the body. In men, it is produced by specialized cells in the testes; in women, it is produced in the ovaries. It can also be secreted by the adrenal cortex on the kidneys (Mazur & Booth, 1998). Because it is related to male sexual development and functioning, this hormone was traditionally targeted as an explanation for why men tend to be more physically aggressive than women. In other words, there was an assumption that testosterone *causes* aggression. Scientific studies paint a slightly more complex picture.

What do we know about testosterone and aggression?

There is a large body of research linking testosterone and aggression. In one experiment, researchers castrated a group of mice, an experience that obviously reduced their testosterone levels. The castrated mice as well as a control group of healthy mice then encountered an aggressive mouse. Although this type of interaction would usually lead to physical fights, the castrated mice showed almost no aggressive response (Beeman, 1947). However, when castrated mice received an injection of testosterone prior to the interaction, they did respond aggressively. This study suggested a causal link between

testosterone and aggression. Human research also indicates a similar relationship. High testosterone levels were associated with a history of violent crime (e.g., murder, armed robbery) in both male and female prisoners (Dabbs et al., 1995; Dabbs & Hargrove, 1997). Prisoners who were jailed for less violent crimes had lower testosterone levels. Thus, both animal and human research has historically shown *some* link between testosterone and aggression.

How can science explain the relationship between testosterone and aggression?

Scientific studies show that the relationship between testosterone and aggression is more specific than was once thought. Testosterone appears to be involved with social aggression and dominance rather than with non-social forms of aggression such as hunting or responding to attacks (Eisenegger et al., 2011). Dominance involves an individual striving for or attempting to maintain a high social status. In animals, such a status is often linked with increased access to food and potential mates. In many primate species such as rhesus monkeys, dominance is achieved non-violently through stares, threatening body language, and shouts rather than through physical contact (Higley et al., 1996). It is also associated with higher testosterone levels. In studies with human participants, socially dominant adolescents and adults tended to have higher levels of testosterone (Carré et al., 2009; Rowe et al., 2004).

Testosterone also increased when participants perceived a potential threat to their status. Chimpanzees who anticipate competing for access to food show an elevated testosterone response (Wobber et al., 2010). In humans, several studies have found that competition was linked with increased testosterone, with activities ranging from wrestling and tennis to chess (Booth

et al., 1989; Mazur et al., 1992)! Importantly, higher testosterone levels were found for winners than for losers, again suggesting a link between this hormone and social dominance (Oliveira et al., 2009).

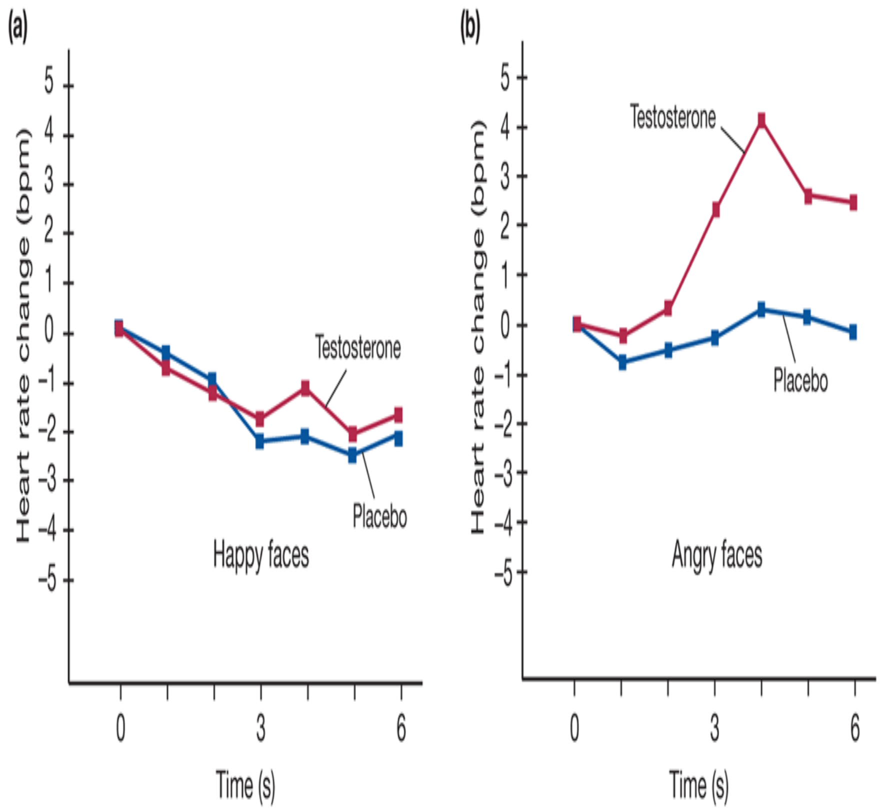
Can we critically evaluate this research?

One concern with many of these studies is that they are correlational. As you read in Module 2.2, correlational designs show a relationship between two variables but cannot be used to state that one causes the other. For instance, it is impossible to say if winning led to an increase in testosterone or if players with higher testosterone levels were more likely to win. In order to deal with this concern, some researchers have manipulated the competitions so that one player or the other wins. The results of these studies showed that winning *leads to* an increase in testosterone (e.g., Schultheiss et al., 2005).

Another question that arises is how does testosterone actually affect behaviour? What does testosterone do to allow people and animals to become (or feel) more socially dominant? Several studies suggest that injections of testosterone lead to less socially minded behaviour (Eisenegger et al., 2011). For instance, in most situations, people tend to subtly mimic the facial expressions of others; this makes the other person feel like they are being understood and increases social bonds. Researchers have found that injections of testosterone decrease facial mimicry (Hermans et al., 2006). Participants who have received testosterone are also more aware of potential threats. When you perceive a happy face, it does not likely cause any alarm. The same is true for people who have received an injection of testosterone (see Figure 3.17). However, when these same individuals view an angry face—which *is* a potential threat—their heart rate increases much more than the heart rates of control participants (van Honk et al.,

2001). Together, these studies suggest that testosterone alters behaviours that would promote social bonding, thus making the individual more likely to respond with social aggression.

Figure 3.17 Testosterone and Social Threat



Individuals who received an injection of testosterone showed much larger heart rate responses to threatening faces than did control participants. The groups did not differ when viewing non-threatening happy faces.

Source: Republished with permission of Elsevier Science, Inc., from Eisenegger, C., Haushofer, J., & Fehr, E. (2011). The role of testosterone in social interaction. *Trends in Cognitive Sciences 15*(6), by. Permission conveyed through Copyright Clearance Center, Inc.

Why is this relevant?

These studies demonstrate that testosterone is not simply related to aggression. Instead, it is related to *social* aggression. Although this still means that this hormone could be linked with violent

crime (which is, in some ways, a form of dominance), social dominance also has an evolutionary purpose. Dominant individuals are more likely to survive (and therefore reproduce) in many species. They would receive better food and access to mates. They would also experience less stress caused by attacks from dominant members of the group. Therefore, although we don't think of social aggression as being as a good thing, testosterone likely helped our ancestors to survive while others did not.

Neurons in Context

Listen to the Audio

When reading about neuronal structures, neurotransmitters, and hormones, it is easy to lose sight of how these cells and molecules fit together with discussions of genetics (Module 3.1) and larger brain structures (Module 3.3). In the last few years, a number of genes related to different neurotransmitters have been identified. These genes can influence how the neurotransmitters are formed as well as processes such as reuptake. These seemingly minor differences in genes can affect neurotransmitter levels and thus how neurons communicate with each other. This alters the networks of neurons firing together in the brain; these networks of structures produce your thoughts, movements, and sensations. So, while a discussion of brain cells seems far removed from the science of behaviour, these brain cells are, in fact, what makes you "you."

Module 3.2 Summary

Listen to the Audio

3.2a Know . . . the key terminology associated with nerve cells, hormones, and their functioning.

Review Module 3.2

Start Over Swap

0/36 REVIEWED · 0 MASTERED

neurotransmitters

Previous Next Got It!

3.2b Understand . . . how nerve cells communicate.

Nerve cells fire because of processes involving both electrical and chemical factors. A stimulated nerve cell goes from resting potential to

action potential following an influx of positively charged ions inside the membrane of the cell. As the message reaches the end of the nerve cell, neurotransmitters are released into synapses and bind to neighbouring postsynaptic cells. Depending on the type of neurotransmitter, the effect can be either inhibitory or excitatory.

3.2c Understand . . . the ways that drugs and other substances affect the brain.

Drugs can be agonists or antagonists. A drug is an agonist if it enhances the effects of a neurotransmitter. This outcome occurs if the drug increases the release of a neurotransmitter, blocks reuptake, or mimics the neurotransmitter by binding to the postsynaptic cell. A drug is an antagonist if it blocks the effects of a neurotransmitter. Antagonists block neurotransmitter release, break down neurotransmitters in the synapse, or block neurotransmitters by binding to postsynaptic receptors.

3.2d Understand . . . the roles that hormones play in our behaviour.

Hormones have multiple influences on behaviour. The nervous system—in particular, the hypothalamus—interacts with the endocrine system in controlling the release of hormones. A few of humans' many hormonally controlled responses include reactions to stress and pain as well as sexual responses. Some hormones are associated with, though not necessarily a primary cause of, aggressive behaviour.

3.2e Apply . . . your knowledge of neurotransmitters to understand how they relate to common diseases and psychological disorders.

Apply Activity

On the left side of Table 3.2, we have listed several diseases and clinical symptoms. Please indicate which neurotransmitter is *most likely* involved with each condition. The potential answers are: acetylcholine, dopamine, glutamate, GABA, norepinephrine, and serotonin.

Table 3.2 Match the Neurotransmitter to the Clinical Condition

Study the table. Then, select "Check Your Understanding" to test your knowledge.

Disease or Symptoms	Neurotransmitter
Parkinson's disease, a common movement disorder, is caused by the destruction of neurons that release which neurotransmitter?	Dopamine
A common treatment of depression involves medications that block the reuptake of which neurotransmitter?	Serotonin
Abnormally low levels of this neurotransmitter can lead to seizures, as is sometimes the case in epilepsy.	GABA
Low levels of this neurotransmitter would reduce the efficiency of neuromuscular junctions, where neural impulses stimulate muscle movements.	Acetylcholine

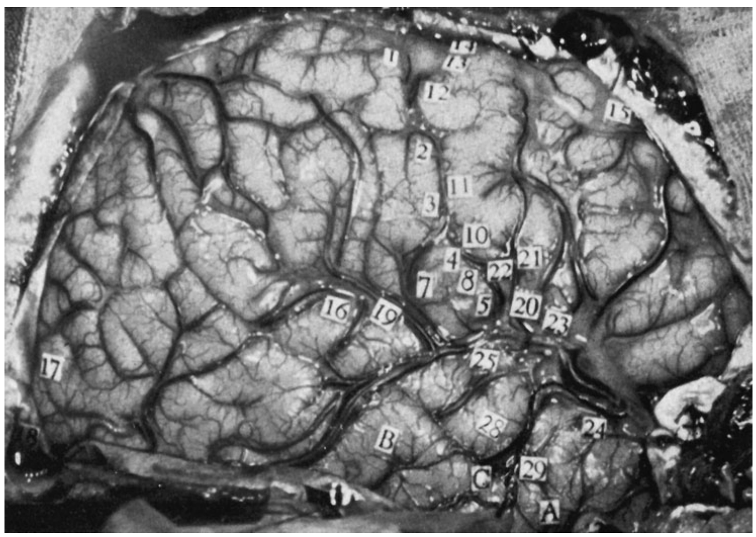
Check Your Understanding

3.2f Analyze . . . the claim that we are born with all the nerve cells we will ever have.

Earlier in this module, a Myths in Mind feature addressed the question of whether we are born with all of the nerve cells we will ever have. Although scientists once believed this to be true, we now know that neurogenesis—the growth of new neurons—takes place in several parts of the brain. One of these regions is the hippocampus, which is involved in learning and memory, anxiety and stress responses, and the inhibition of behaviour (see Module 7.1).

Module 3.3 Structure and Organization of the Nervous System

Listen to the Audio



Montreal Neurological Hospital and Institute

Learning Objectives

3.3a Know . . . the key terminology associated with the structure and organization of the nervous system.

3.3b Understand . . . how studies of split-brain patients reveal the workings of the brain.

3.3c Apply . . . your knowledge of brain regions to predict which abilities might be affected when a specific area is injured or

diseased.

3.3d Analyze . . . whether neuroplasticity will help people with brain damage.

The story has become something of a legend in neuroscience: Dr. Wilder Penfield, a doctor at the Montreal Neurological Institute, was electrically stimulating different parts of a woman's brain prior to her surgery to remove the brain tissue causing her seizures. In addition to mapping out the location of important brain areas such as those related to language, Penfield was also hoping to stimulate sensations similar to those experienced by the patient just prior to the onset of her seizures. (In this case, the sensation was the smell of burnt toast.) This information would provide insights into where in the brain her seizures were beginning. After one electrical stimulation, the patient reported that she could see wonderful lights. After another electrical burst, she asked if Dr. Penfield had poured cold water on her hand. Finally, according to legend, the patient said, "Dr. Penfield! I can smell burnt toast!"

In addition to showing us that early brain researchers were part scientist and part detective, this story makes an important point about the organization of the brain: Different parts of the brain are related to different functions, including sensations, memories, and emotions. In this module, we will discuss many of the important brain regions related to the biology of behaviour.

In this module, we translate our knowledge of nerve cells into an understanding of how they work as an integrated system. This section is rich with terminology and can be challenging. As you read through it, try to think about how the different parts of the nervous system apply to your own behaviour and experiences. Doing so will help you remember the

terms, and will also show you that many different parts of your nervous system interact when you perform even the simplest of behaviours.

Divisions of the Nervous System

Listen to the Audio

Think about it: billions of cells work together to let you have a personality, feel emotions, dance, enjoy music, and remember all of the ups and downs you experience in life. In addition to these voluntary activities, the nervous system is also involved in a number of involuntary processes like controlling your heart rate, blinking, and breathing. Given these diverse functions, it shouldn't be surprising to hear that the nervous system has a number of divisions that allow these processes to take place seamlessly. We begin our exploration of the nervous system by examining the most basic of these distinctions—the difference between the central and peripheral nervous systems.

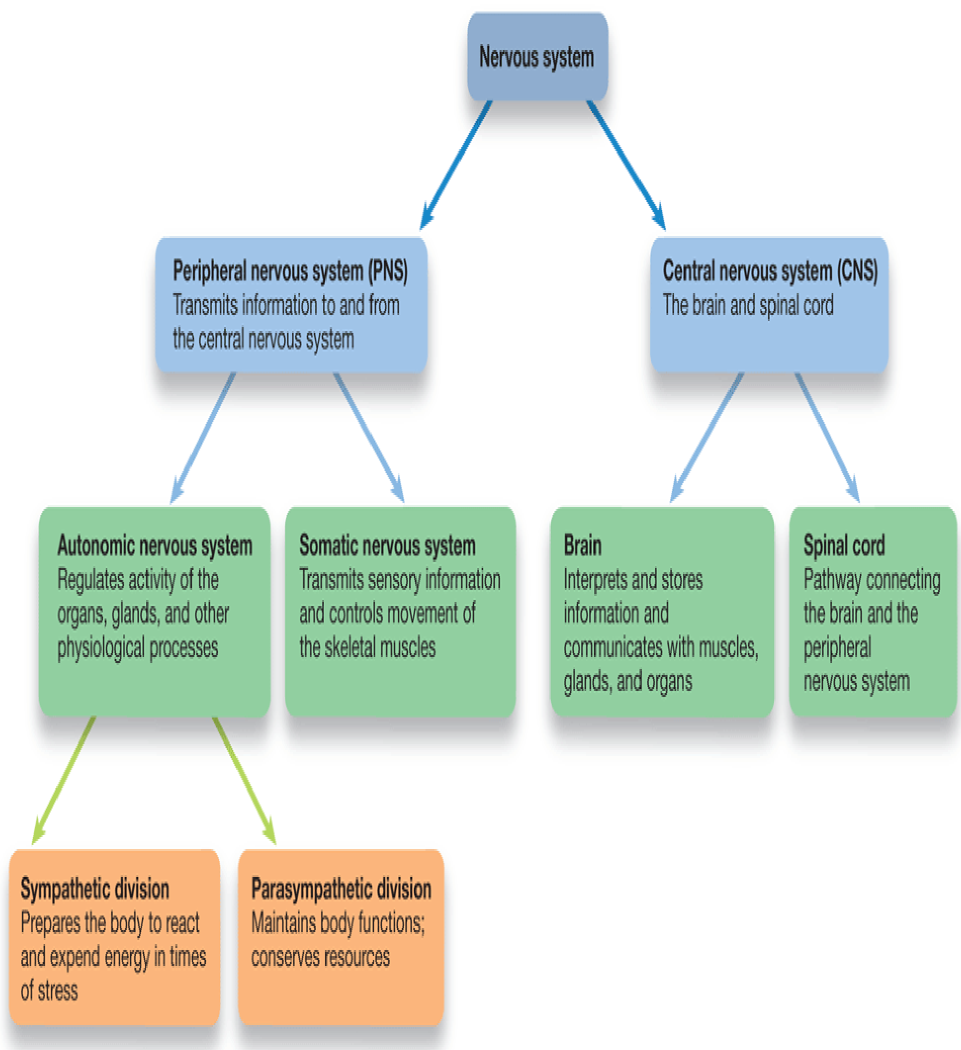
The Central Nervous System

Listen to the Audio

Look up from this page and examine the objects around you. What are they? Can you use words to describe them? How would you use them? Your ability to think up answers to these questions involves different parts of your central nervous system. The **central nervous system (CNS)** *consists of the brain and the spinal cord* (see Figure 3.18). The human brain is perhaps the most complex entity known. Its capacity to store information is almost limitless. Your personality, preferences, memories, and conscious awareness are all packed into this three-pound structure made up of approximately 100 billion individual neurons. The other part of the CNS, the spinal cord, runs from your neck down to the base of your spine. The spinal cord receives information from the brain and stimulates nerves that extend out into the body; this stimulation produces movements. It also receives information from sensory nerves in the body and transmits it back to the brain (or, in the case of reflexes, organizes rapid movements *without* the help of the brain). These two structures are critical for our survival. But our ability to move and to sense the outside world would be impossible without another major division of the nervous system.

Watch Spinal Cord Reflex

Figure 3.18 The Organization of the Nervous System



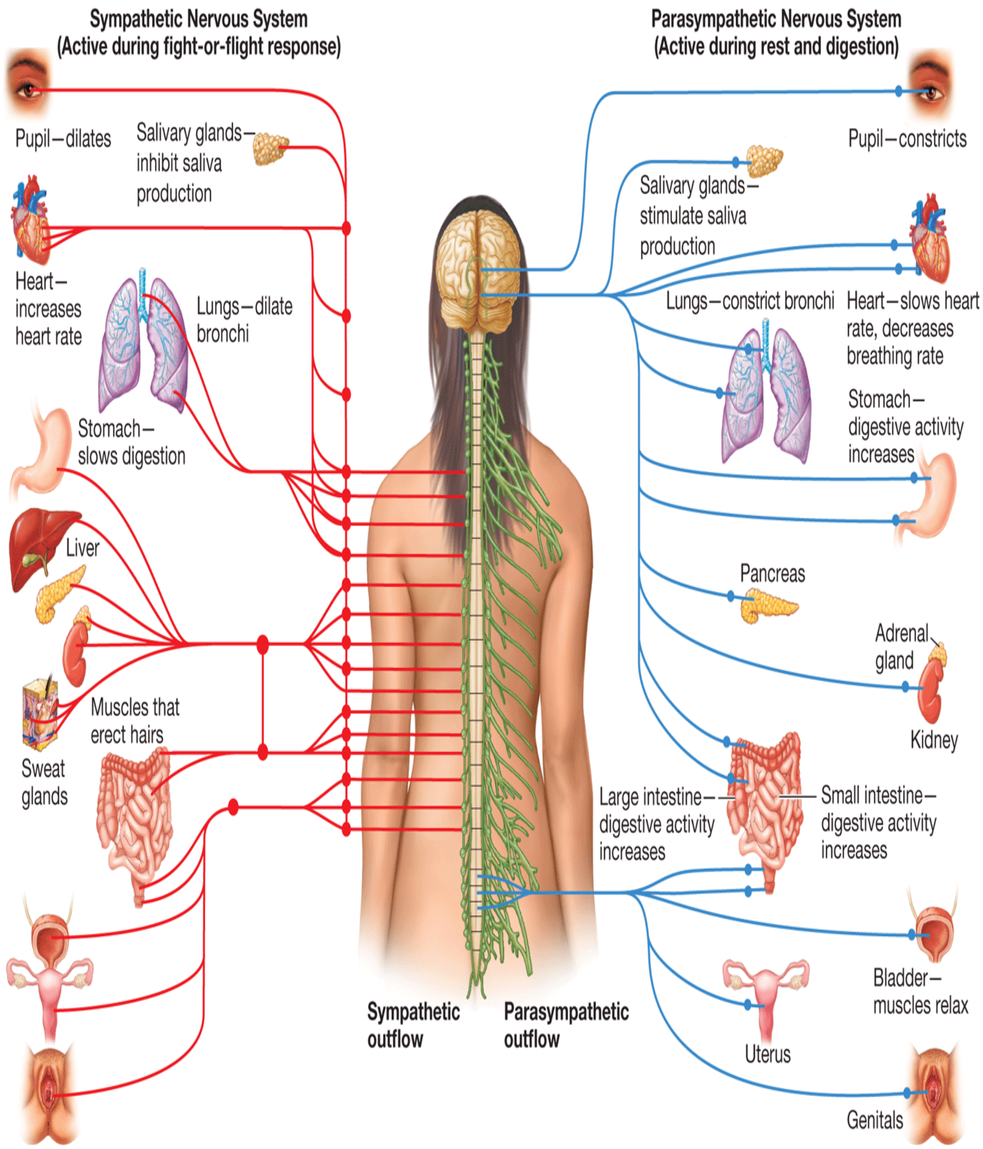
The nervous system can be divided into several components, each with a specific set of structures and functions.

The Peripheral Nervous System

Listen to the Audio

Run your fingers along the side of the chair that you are sitting in. Now, move your hands so that your index fingers are touching each other. In both of these instances, you are sending information from your central nervous system to the nerves in the rest of your body that control movement. You are also receiving sensory input from your body as you interact with your environment. These processes are performed by the **peripheral nervous system (PNS)**, a *division of the nervous system that transmits signals between the brain and the rest of the body and is divided into two subcomponents: the somatic system and the autonomic system* (see Figure 3.19). The **somatic nervous system** *consists of nerves that control skeletal muscles, which are responsible for voluntary and reflexive movement; it also consists of nerves that receive sensory input from the body*. This would be the division of the PNS that is active when you feel the edge of a chair or move your hands. Any voluntary behaviour, such as coordinating the movements needed to reach, walk, or move a computer mouse, makes use of the somatic nervous system.

Figure 3.19 The Autonomic Nervous System



The sympathetic and parasympathetic divisions of the autonomic nervous system control and regulate responses of the glands and organs of the body.

Source: Lilienfeld, S. O., Lynn, S., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, Books A La Carte Edition, 2nd Ed., ©2011. Reprinted and Electronically reproduced by permission of Pearson Education, Inc., New York, NY.

But not all behaviours are voluntary. For example, it is unlikely that you can make your heart race or your palms sweat. Responses such as these are often automatic, occurring outside of our conscious control. These behaviours are performed by the **autonomic nervous system**, *the*

portion of the peripheral nervous system responsible for regulating the activity of organs and glands. This system includes two subcomponents: one that increases our ability to make rapid responses, and one that helps us return to normal levels of emotional arousal. The **sympathetic nervous system** *is responsible for the fight-or-flight response of an increased heart rate, dilated pupils, and decreased salivary flow—responses that prepare the body for action*. If you hear footsteps behind you as you are walking alone or if you barely avoid an accident while driving, then you will experience *sympathetic* arousal. In this process, blood is directed toward your skeletal muscles, heart rate and perspiration increase, and digestive processes are slowed; each of these responses helps to direct energy where it is most needed in case you need to respond. However, if you remained in this heightened state of emotional arousal, you would quickly run out of energy resources. It is therefore important for you to have a system in place that allows your body to quickly return to normal levels of energy use. The **parasympathetic nervous system** *helps maintain homeostatic balance in the presence of change; following sympathetic arousal, it works to return the body to a baseline, non-emergency state*. Generally speaking, the parasympathetic nervous system does the opposite of what the sympathetic nervous system does (see Figure 3.19).

So, if you thought you saw a snake beside your foot (CNS), you would have a sympathetic nervous system (PNS) response that would increase your heart rate and would send blood toward your leg muscles. Your brain (CNS) would initiate a movement and send that order down the spinal cord (CNS), where it would project out from spinal nerves (PNS) that influence the activity of muscles. Sensory feedback (PNS) from the skin and muscles would travel back to the spinal cord (CNS) and up to the brain (CNS). After some time had passed and you realized that it was actually a stick, not a snake (CNS), your parasympathetic nervous system (PNS) would help you calm down so that you were no longer frightened and no longer using up all of your energy responding to this stimulus.

Although these different parts of the PNS and CNS clearly influence a number of our responses, many of the functions of the PNS are relatively simple. Most of our complex behaviours, including our ability to think and reason, is directed by the brain, a stunningly complex structure made up of hundreds of smaller parts. Therefore, the rest of this module will focus on explaining how the different parts of this biological marvel function, alone and in larger networks.

The Brain and Its Structures

Listen to the Audio

The brain is divided into two **cerebral hemispheres**, *nearly symmetrical halves of the brain that contain the same structures*, although there are some small differences in the size of these brain areas (Springer & Deutsch, 1998). Within each hemisphere, the structures of the brain are organized in a hierarchical fashion. The human brain, as well as that of other animals, can be subdivided into three main regions: the hindbrain, the midbrain, and the forebrain (Table 3.3). This system of dividing the brain may tempt you to view it as a mass of separate compartments. Keep in mind that the entire brain is composed of highly integrated circuitry and feedback loops. In other words, although the forebrain may perform complex thinking processes, like decision making, its activity is influenced by (and influences) structures in the midbrain and the hindbrain.

Table 3.3 Major Brain Regions, Structures, and Their Functions

Table 3.3 Major Brain Regions, Structures, and Their Functions

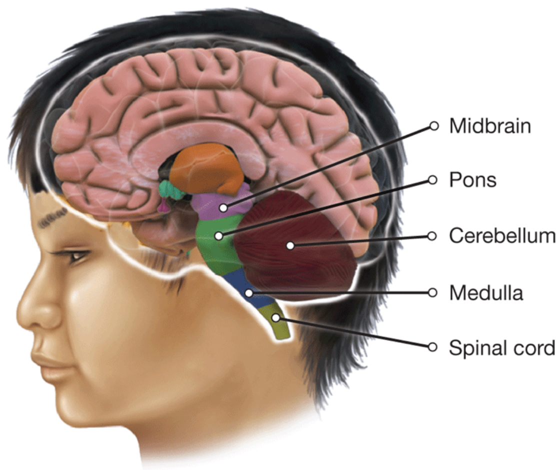
Regions and Structures	Functions
Hindbrain	
Brainstem (medulla and pons)	Breathing, heart rate, sleep, and wakefulness
Cerebellum	Balance, coordination and timing of movements; attention and emotion
Midbrain	
Superior colliculus	Orienting visual attention
Inferior colliculus	Orienting auditory attention
Forebrain	
Basal ganglia	Movement, reward processing
Amygdala	Emotion
Hippocampus	Memory
Hypothalamus	Temperature regulation, motivation (hunger, thirst, sex)
Thalamus	Sensory relay station
Cerebral Cortex	
Occipital lobe	Visual processing
Parietal lobe	Sensory processing, bodily awareness
Temporal lobe	Hearing, object recognition, language, emotion
Frontal lobe	Thought, planning, language, movement

The Hindbrain: Sustaining the Body

Listen to the Audio

The hindbrain consists of structures that are critical to controlling basic, life-sustaining processes. At the top of the spinal cord is a region called the **brainstem**, *which is the "stem" or bottom of the brain and consists of two structures: the medulla and the pons* (Figure 3.20). Nerve cells in the medulla connect with the body to perform basic functions such as regulating breathing, heart rate, sneezing, salivating, and even vomiting—all those actions your body does with little conscious control on your part. The fact that the medulla can control all of these activities without us consciously controlling our responses is important—without this ability, our lives would consist of nothing more than sending signals to various organs to ensure that we stayed alive. The pons contributes to general levels of wakefulness and also appears to have a role in dreaming (see Module 5.1). Due to its connections to other structures in the brain and spinal cord, the pons is also part of a number of networks including those that control balance, eye movements, and swallowing (Nolte, 1999).

Figure 3.20 The Hindbrain and Midbrain



Structures in the hindbrain are responsible for basic functions that sustain the body. The midbrain includes structures that control basic sensory responses and voluntary movement.

Source: Lilienfeld, S. O., Lynn, S., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed., ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

An additional hindbrain structure, the **reticular formation**, *extends from the medulla upwards to the midbrain* (described shortly) *and is involved with attention and alertness*. When you wake up in the morning, you can thank (in part) your reticular formation. This structure also communicates with cells in the spinal cord involved with movements related to walking and posture.

The structures in the hindbrain are able to influence a number of behaviours through their connections to other parts of the brain and spinal cord. They also have dense connections with another hindbrain structure, the cerebellum. The **cerebellum** (Latin for "little brain") *is the lobe-like structure at the base of the brain that is involved in the monitoring of movement, maintaining balance, attention, and emotional responses*. The cerebellum's role in movement has been known for almost two centuries (Flourens, 1824; Schmahmann, 2004). Damage to this structure leads to uncoordinated and jerky movements that interfere with walking, posture, and most limb movements. These symptoms suggest that the cerebellum

is involved with coordinating and timing ongoing movements rather than with generating responses on its own (Yamazaki & Tanaka, 2009). However, recent research indicates that these timing functions extend beyond movement. Patients with damage to the cerebellum have difficulty controlling their attention (Schweizer, Oriet, et al., 2007). They also have problems with emotional control, including personality changes and impulsivity, a set of symptoms now known as the *cognitive affective behavioural syndrome* (Schmahmann & Sherman, 1998). The cerebellum is likely able to influence this wide variety of functions because it has dense connections to a number of areas in the forebrain as well as to evolutionarily older structures in the base of the brain like the hypothalamus, a structure related to the autonomic nervous system (Stoodley & Schmahmann, 2010; Zhu et al., 2006). Through these connections, the so-called "little brain" is able to have a big effect on behaviour.

The Midbrain: Sensation and Action

Listen to the Audio

The cerebellum is not the only neural region involved with both movement and attention. The **midbrain**, which *resides just above the hindbrain, primarily functions as a relay station between sensory and motor areas* (Figure 3.20). For example, have you ever detected a sudden movement out of the corner of your eye? This ability to capture your visual attention is influenced by the *superior colliculus* (plural *colliculi*). Of course, your ability to orient your attention is not limited to visual stimuli. How do you respond when someone's phone rings in class? You, quite naturally, pay attention to that new sound and turn your head toward its source (while mentally judging the person's ringtone). This ability to move your auditory attention is influenced by another midbrain structure, the *inferior colliculus* (plural *colliculi*).

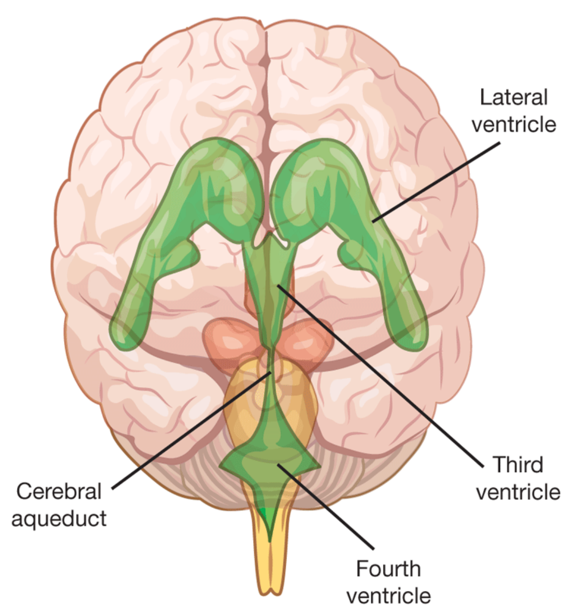
Like the hindbrain, structures in the midbrain do not act as independent units; rather, they are part of much larger networks. This concept is powerfully illustrated by the *substantia nigra*. This midbrain area has connections to structures in the forebrain (to be discussed shortly); this network of dopamine-releasing cells is involved with the control of movements. **Parkinson's disease**—*a condition marked by major impairments in voluntary movement*—is caused by a loss of the dopamine-producing cells in this network.

The Forebrain: Emotion, Memory, and Thought

Listen to the Audio

The **forebrain**, *the most visibly obvious region of the brain, consists of all of the neural structures that are located above the midbrain, including all of the folds and grooves on the outer surface of the brain; the multiple interconnected structures in the forebrain are critical to such complex processes as emotion, memory, thinking, and reasoning*. The forebrain also contains spaces called *ventricles* (Figure 3.21). Although the ventricles appear hollow, they are filled with cerebrospinal fluid, a solution that helps to eliminate wastes and provides nutrition and hormones to the brain and spinal cord. Cerebrospinal fluid also cushions the brain from impact against the skull.

Figure 3.21 The Cerebral Ventricles

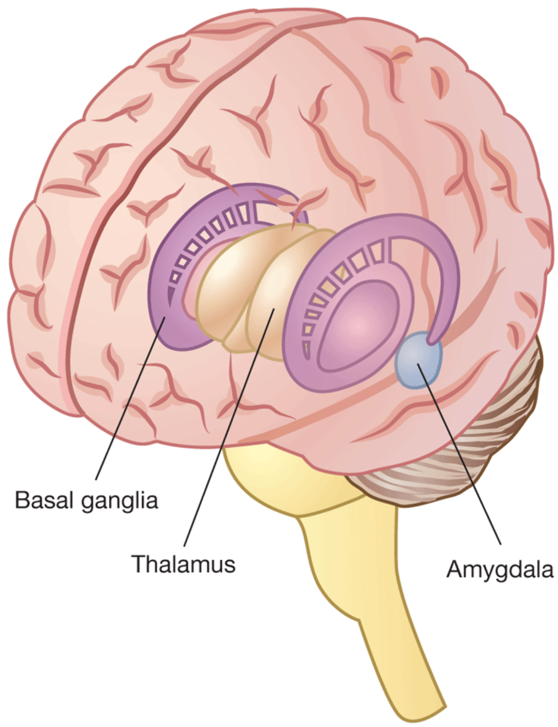


Four ventricles in the brain contain cerebrospinal fluid. This provides nutrition and cushioning for many parts of the brain.

Source: Carlson, N. R. (2013). *Physiology of Behaviour*, 11th ed., ©2013, pp. 29, 72. Reprinted and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

Sitting next to the ventricles are the **basal ganglia**, *a group of three structures that are involved in facilitating planned movements, skill learning, and integrating sensory and movement information with the brain's reward system* (Figure 3.22). The basal ganglia form networks that promote and inhibit movements. These two networks interact to allow us to have our different muscles work together in the correct sequence rather than having them "flex" at random times. People who are very practised at a specific motor skill, such as playing an instrument or a sport, have actually modified their basal ganglia through practice to better coordinate engaging in the activity (Yarrow et al., 2009). Improper functioning of the basal ganglia can lead to movement disorders like Parkinson's disease and **Huntington's disease**, *a condition involving uncontrollable movements of the body, head, and face*. The basal ganglia are also affected in people who have **Tourette's syndrome**—*a condition marked by erratic and repetitive facial and muscle movements (called* tics*), heavy eye blinking, and frequent noise making such as grunting, snorting, or sniffing*. The excess dopamine that appears to be transmitted within the basal ganglia contributes to many of the classic Tourette's symptoms (Baym et al., 2008). Incidentally, contrary to popular belief, the shouting of obscenities (*coprolalia*) is actually relatively uncommon in people with Tourette's syndrome.

Figure 3.22 The Basal Ganglia



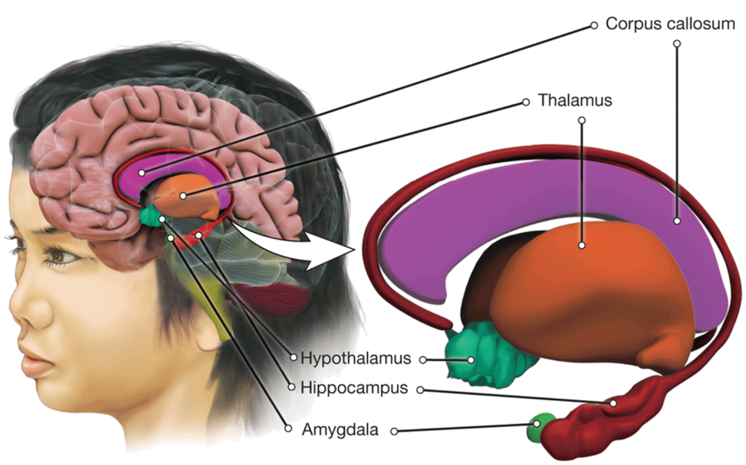
The basal ganglia function in both voluntary movement and responses to rewarding stimuli.

Some parts of the basal ganglia are also involved in emotion, particularly experiences of pleasure and reward (Berridge et al., 2009). These structures respond to different types of rewards including tasty foods like chocolate (Small et al., 2003) and monetary rewards (Elliott et al., 2003). They also form a network with a nearby structure—the *nucleus accumbens* —whose activity accompanies many kinds of pleasurable experiences, including sexual excitement and satisfying a food craving (Avena et al., 2008). As you will read in Module 5.3, this basal ganglia–nucleus accumbens network is also related to the pleasurable effects caused by some drugs (Uchimura & North, 1990).

Another major set of forebrain structures comprises the **limbic system**, *an integrated network involved in emotion and memory* (Maclean, 1952; see Figure 3.23). One key structure in the limbic system is the **amygdala**, *which facilitates memory formation for emotional events, mediates fear*

responses, and appears to play a role in recognizing and interpreting emotional stimuli, including facial expressions. In addition, the amygdala connects with structures in the nervous system that are responsible for adaptive fear responses such as freezing in position when a possible threat is detected; it is also connected to areas responsible for attention, which is why you usually notice when a spider is on your wall. Just below the amygdala is another limbic structure called the hippocampus (Greek for "seahorse"—something it physically resembles if you've had a few drinks). The **hippocampus** *is critical for learning and memory, particularly the formation of new memories* (Squire et al., 2007; see Module 7.1).

Figure 3.23 The Limbic System



Structures in the limbic system include the hypothalamus, hippocampus, and amygdala, which play roles in regulating motivation, memory, and emotion.

You already encountered the *hypothalamus* in Modules 3.2 when you read about its relationship to the endocrine system, and you will encounter it again in Module 11.1 when you read about its influence on the regulation of hunger and thirst and in Module 11.2 when you read

about its influence on sexual behaviours. The hypothalamus serves as a sort of thermostat, maintaining the appropriate body temperature, and it regulates drives such as aggression and sex by interacting with the endocrine system. In fact, regions of the hypothalamus trigger orgasm for both females and males (Meston et al., 2004; Peeters & Giuliano, 2007). Direct electrical stimulation of parts of the hypothalamus can produce intense physical pleasure. In a classic set of studies in the 1950s, Olds (1958) found that rats who could press a lever to stimulate the lateral (outside part) of the hypothalamus did so for hours on end, often forgoing food and sleep in order to repeatedly press the lever. In fact, the rats were willing to cross a painful electrical grid in order to reach the lever so that they could return to stimulating themselves. (Ethical considerations have prevented researchers from performing similar experiments with Introductory Psychology students.)

Another important, albeit less arousing, forebrain structure is the **thalamus**, *a set of nuclei involved in relaying sensory information to different regions of the brain*. Most of the incoming sensory information, including what we see and hear, is routed through specific nuclei in the thalamus. Different types of information are processed by different nuclei before being sent to more specialized regions of the brain for further processing (Sherman, 2007; Sherman & Guillery, 1996). Many of these regions are found in the outer layer known as the cerebral cortex.

The Cerebral Cortex

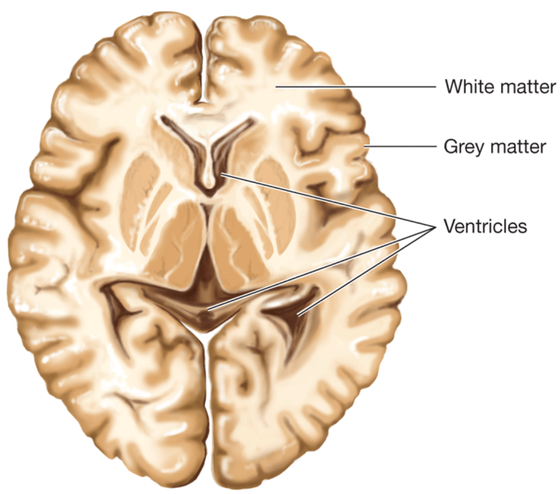
Listen to the Audio

The **cerebral cortex** *is the convoluted, wrinkled outer layer of the brain that is involved in multiple higher functions, such as thought, language, and personality*. This highly advanced, complex structure has increased dramatically in size as the primate brain has evolved (Kouprina et al., 2002; see Module 3.1). The wrinkled surface of the brain seems to have solved a biological problem endured by our species, as well as by many other mammals: how to pack more cells (i.e., more computing power) into the same amount of space. Because the skull can only be so large, the brain has countered this constraint by forming a wrinkled surface, thereby increasing the surface area of the cortex. More surface area means more neurons and, likely, greater cognitive complexity.

The cerebral cortex consists primarily of the cell bodies and dendrites of neurons; these parts of the neuron give the outer part of the brain a grey-brown colour. The axons of these neurons extend throughout the brain and allow communication between different neural regions to occur. Most of these axons are wrapped in a white, fatty substance called myelin (see Module 3.2), which helps speed up the transmission of neural impulses. Figure 3.24 shows a slice of the brain revealing contrasting light and dark regions, known as *white matter* and *grey matter*. When you see an image like Figure 3.24, it is easy to underestimate the complexity of the brain and its connections. Just to put this image into perspective:

- The grey matter of the brain consists of approximately 100 billion neurons (Drachman, 2005).
- The white matter of a 20-year-old male brain would extend approximately 176 000 km; for a 20-year-old female brain, it would extend approximately 149 000 km (Marner et al., 2003).
- Healthy adults have between 100 and 500 trillion synapses, or connections between cells (Drachman, 2005). Each of these synapses can fire several times a second. That is a considerable amount of computing power.

Figure 3.24 Grey and White Matter of the Brain



The cerebral cortex includes both grey matter and white matter, which consist of myelinated axons. Also seen here are the ventricles of the brain. These cavities within the brain are filled with cerebrospinal fluid that provides nourishment and exchange of chemicals with the brain as well as its protective structure.

Source: Lilienfeld, Scott O.; Lynn, Steven J; Namy, Laura L.; Woolf, Nancy J., *Psychology: From Inquiry to Understanding*, 2nd Ed., ©2011. Reprinted And Electronically Reproduced By Permission Of Pearson Education, Inc., New York, NY.

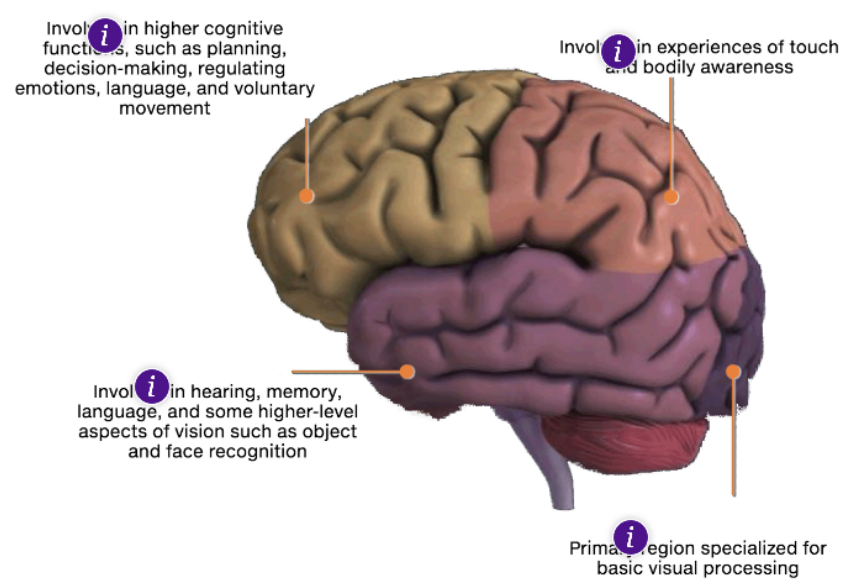
The Four Lobes

Listen to the Audio

In each cerebral hemisphere, the cortex forms the outer surface of four major areas known as *lobes*: the occipital, parietal, temporal, and frontal lobes (Figure 3.25). Each of the cerebral lobes has a particular set of functions. Nerve cells from each of the four lobes are interconnected, however, and also have connections with regions of the midbrain and hindbrain already described.

Figure 3.25 The Four Lobes of the Cerebral Cortex

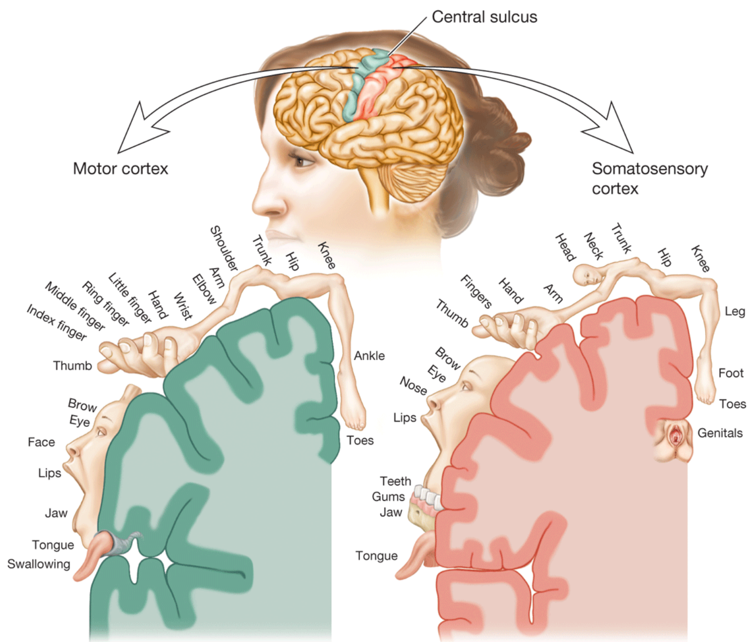
The cerebral cortex is divided into the frontal, parietal, occipital, and temporal lobes. Review the function of each lobe and see if you can identify which lobe is which. Then select the circle to reveal the answer.



The **occipital lobes** *are located at the rear of the brain and are where visual information is processed*. The occipital lobes receive visual information from the thalamus. After processing this information, they send it out along two visual pathways, one that projects to the temporal lobes and is involved with object recognition and one that projects to the parietal lobes and is involved with using vision to guide our movements (Milner & Goodale, 2006).

The **parietal lobes** *are involved in our experiences of touch as well our bodily awareness*. At the anterior (front) edge of the parietal lobe is the *somatosensory cortex*—a band of densely packed nerve cells that register touch sensations. The amount of neural tissue dedicated to a given body part in this region is roughly based on the number of sensory receptors present at each respective body region. For instance, the volume of nerve cells in the somatosensory cortex corresponding to the face and hands is proportionally greater than the volume of cells devoted to less sensitive regions like the torso and legs. This is because we acquire more sensory information from our face and hands than we do from most other body parts; very few people use their stomach when trying to identify objects by touch. This difference in the amount of space in the somatosensory cortex allocated to different parts of the body is depicted in Figure 3.26; figures such as this are referred to as a *homunculus* or "little man."

Figure 3.26 The Body as Mapped on the Motor Cortex and Somatosensory Cortex

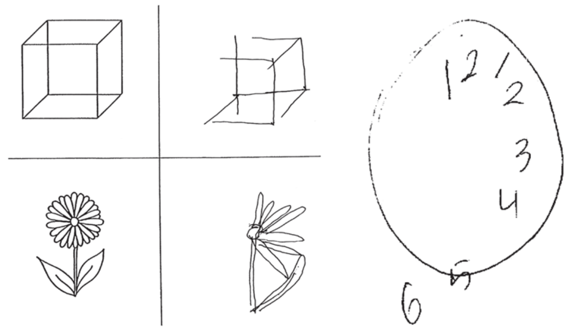


The regions of the motor cortex are involved in controlling specific body parts. The somatosensory cortex registers touch and other sensations that correspond to the body region depicted. Why do you think it is evolutionarily useful to have these two cortices next to each other in the brain?

Source: Marieb, E. N., & Hoehn, K. (2007). *Human Anatomy And Physiology*, 7th Ed., ©2007, p. 438. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Regions within the parietal lobes also function in performing mathematical, visuospatial, and attention tasks. Damage to different regions of the parietal lobe can lead to specific impairments. For instance, right parietal lobe damage can lead to **neglect**, *a situation in which the patient does not attend to anything that appears in the left half of his or her visual field* (Heilman & Valenstein, 1979; Hughlings Jackson, 1876/1932); examples of a neglect patient's drawings are shown in Figure 3.27.
Neglect can even occur for the left half of the patient's *imagined* visual images (Bisiach & Luzatti, 1978)!

Figure 3.27 Unilateral Neglect



Patients with damage to the right parietal lobe sometimes show evidence of neglect, a failure to attend to the left half of their visual field.

The **temporal lobes** *are located at the sides of the brain near the ears and are involved in hearing, language, and some higher-level aspects of vision such as object and face recognition*. Different sections of the temporal cortex perform different roles. The superior (top) part of the temporal cortex is known as the *auditory cortex*—it is essential for our ability to hear. Damage to this region leads to **cortical deafness**, *problems with hearing despite the fact that the patient's ears work perfectly* (Mott, 1907). Slightly behind this region, near the back of the temporal lobe, is *Wernicke's area*, which is related to understanding language (Wernicke, 1874). The close proximity of the hearing and language-comprehension areas makes sense, as these two functions are closely related (see Module 8.3 for a detailed discussion of language).

Some of the structures on the bottom surface of the temporal lobes have a key role in memory. These brain areas send information about the objects being viewed and their location or context to the hippocampus, a forebrain structure just discussed (Diana et al., 2007; Eichenbaum et al., 2007). The hippocampus—which is found in the medial or middle portions of the temporal lobes—then sends output to different brain areas, particularly regions of the frontal lobes, showing again that many

different areas of the brain work together to produce almost every behaviour we perform.

The **frontal lobes** *are important in numerous higher cognitive functions, such as planning, regulating impulses and emotions, language production, and voluntary movement* (Goldman-Rakic, 1996). The frontal lobes also allow you to deliberately guide and reflect on your own thought processes. Like the temporal lobes, the frontal lobes can be divided into a number of subsections with specific functions (Miller & Cummings, 2007). A key distinction is between areas related to movement and areas related to the control of our mental lives.

Toward the rear of the frontal lobes is a thick band of neurons that form the *primary motor cortex*, which is involved in the control of voluntary movement. Like the somatosensory cortex discussed above, the primary motor cortex is organized in a homunculus, with different body areas requiring different amounts of space (see Figure 3.26). Body parts such as the fingers that perform fine-motor control will require more space in the motor cortex than areas like the upper thigh, which does not perform many intricate movements. Importantly, motor areas in the frontal lobes are active not just when moving the corresponding body part, but also when planning a movement. This ability to prepare movements before they are needed would clearly be useful when dealing with threats and likely contributed to our species' survival.

The front two-thirds of the frontal lobes are known as the *prefrontal cortex*. This region, which itself can be divided into a number of subsections, performs many of our higher-order cognitive functions such as decision making and controlling our attention. The prefrontal cortex has connections to many of the other brain areas discussed in this module, and appears to help regulate their activity; these control processes are known as *executive functions*. Such functions are not always

necessary; however, when we encounter new situations or need to override our normal responses, the prefrontal cortex is almost always involved (Milner, 1963; Stuss & Knight, 2002).

We would obviously like to find ways to strengthen our executive functions. The Psych@ section provides an interesting technique: exercise.

Psych@

The Gym

Somehow, physical exertion, pain, and breaking down and rebuilding muscle end up making people feel better. But the benefits of exercise do not apply just to one's mood: Exercise also affects cognitive activities such as learning and memory. But how?

In recent years, neuroscientists have begun unravelling the mystery of how exercise benefits brain health. Brain imaging studies have revealed that people who engage in regular exercise show improved functioning of the prefrontal cortex compared to non-exercisers. In addition, people who exercise perform better than non-exercisers on tasks involving planning, scheduling, and multitasking (see Davis et al., 2011; Hillman et al., 2008). Animal studies have shown that exercise increases the number of cells in the hippocampus, which is critical for memory, and increases the quantity of brain chemicals that are responsible for promoting cell growth and functioning (Cotman & Berchtold, 2002). But animals are not the only beneficiaries of an exercise program; similar findings have been reported for

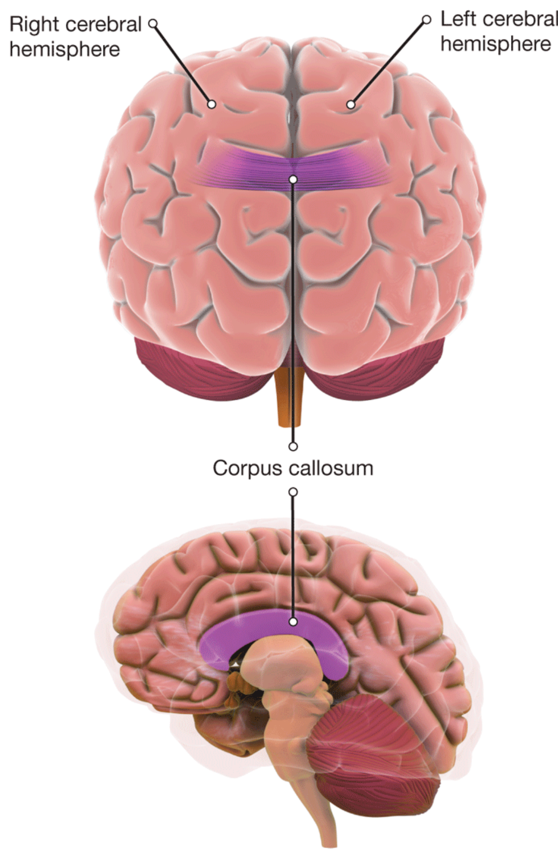
elderly people who regularly engage in aerobic exercise (Erickson et al., 2011).

Despite the clear benefits associated with exercise, many school curricula have dropped physical education in favour of spending more time on preparation for standardized testing. It is not clear that time away from the gym and the playground is having much benefit. A review of 14 studies—12 conducted in the United States, one in British Columbia (Ahamed et al., 2007), and one in South Africa—found a “significant positive relationship” between physical activity and academic performance (Singh et al., 2012). This effect may be due to changes in blood flow to the brain, a reduction in stress due to time away from schoolwork, a positive emotional experience associated with play, or, more likely, a combination of several factors. Science is clearly demonstrating that exercise affects the brain basis of learning and memory (Cotman & Berchtold, 2002; Hillman et al., 2008). These results suggest that provincial governments should *increase*, not *decrease*, funding for physical education in schools. Hopefully these studies will help get that ball rolling.

The four lobes of the brain are found in both of our cerebral hemispheres. It is therefore important to have some way for these brain regions to communicate with each other. This prevents us from having our left and right hemispheres working against each other. In Figure 3.28, you can see that crossing the midline of the brain is a densely concentrated bundle of nerve cells called the **corpus callosum**, *a collection of neural fibres connecting the two cerebral hemispheres*. This thick band of fibres allows the right and left hemispheres to communicate with each other. This communication has an added benefit: It allows the two hemispheres

to work together to produce some of our behaviours. It also opens up the possibility that each hemisphere will become specialized for performing certain functions.

Figure 3.28 The Corpus Callosum



The left and right hemispheres of the brain are connected by a thick band of axons called the corpus callosum.

Source: Lilienfeld, S. O., Lynn, S. J, Namy, L. L. & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed., ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Left Brain, Right Brain: Hemispheric Specialization

Listen to the Audio

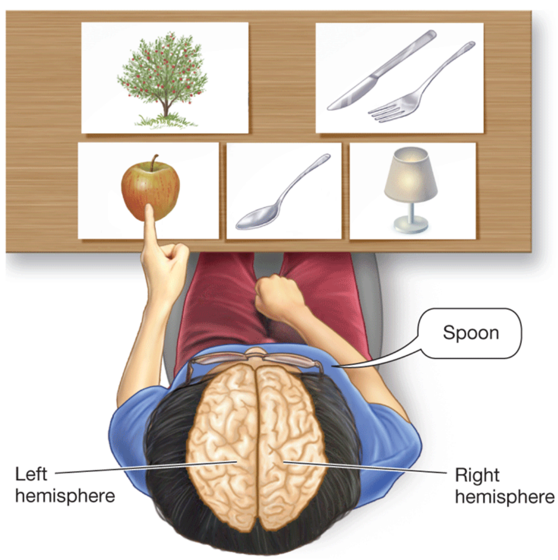
Although they appear to be mirror images of each other, *the two sides of the cortex often perform very different functions, a phenomenon called* **hemispheric specialization**. Speaking in very general terms, the right hemisphere is specialized for cognitive tasks that involve visual and spatial skills, recognition of visual stimuli, and musical processing. In contrast, the left hemisphere is more specialized for language and math (Corballis, 1993; Gazzaniga, 1967, 2000). However, although some hemispheric differences are quite pronounced, many are a matter of degree (Springer & Deutsch, 1998).

Our understanding of hemispheric specialization expanded greatly through work with *split-brain patients*. In the 1960s, physicians hoping to curtail severe epileptic seizures in their patients used a surgical procedure to treat individuals who were not responding to other therapies. The surgeon would sever the corpus callosum, leaving a patient with two separate cerebral hemispheres. This surgery is not as drastic as it might sound. Patients were remarkably normal after the operation, but several interesting observations were made. One was that split-brain patients responded quite differently to visual input that was presented to either hemisphere alone (Sperry, 1982).

To see how this works, take a look at Figure 3.29. Imagine the person pictured has a split brain. She should be able to match the two objects to

her right *and* verbalize the match, because the left side of her visual system perceives the objects and language is processed in the left hemisphere of the brain. In contrast, a visual stimulus presented on the left side of the body would be processed on the right side of the brain. As you can see from Figure 3.29, when the object is presented to the left side of the split-brain patient, the individual does not verbalize which of the objects match, because her right hemisphere is not specialized for language and cannot label the object. If asked to point at the matching object, however, she is able to do so (but only with her left hand, which is controlled by the right hemisphere). Thus, she is able to process the information using her right hemisphere, but cannot articulate it with language.

Figure 3.29 A Split-Brain Experiment



This woman has had a split-brain operation. She is able to verbalize which objects match when they are placed to her right side, because language is processed in the left hemisphere. She cannot verbalize the matching objects on the left, but can identify them by pointing with her left hand (which is controlled by her right hemisphere).

Source: Lilienfeld, S. O., Lynn, S. J, Namy, L. L. & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed., ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Today, split-brain studies are extremely rare, as modern epilepsy medications are often sufficient to treat the symptoms of these patients without the need to sever the corpus callosum. However, the insights gained from these patients still inform our understanding of the brain. It must be stressed, however, that many of these differences are a matter of degree rather than being an absolute one-hemisphere-or-the-other distinction. Indeed, the reality is that most cognitive functions are spread throughout multiple brain regions, with one hemisphere sometimes being superior to the other hemisphere (see Table 3.4).

Table 3.4 Examples of Hemispheric Asymmetries

Table 3.4 Examples of Hemispheric Asymmetries

Left Hemisphere	Right Hemisphere
Language production	Visuospatial skills
Language comprehension	Prosody (emotional intonation)
Word recognition	Face recognition
Arithmetic	Attention (rapid orienting to new stimuli)
Moving the right side of the body	Moving the left side of the body

Before finishing a discussion of the hemispheres, it is also important to point out that the media often misrepresents how hemispheric specialization works. Terms like "left-brained" and "right-brained" are used quite frequently, with the assumption that left-brained people are rigid-thinking accountants who spend hours counting their grey suits and

right-brained people are creative Bohemian artists who flamboyantly wander from experimental art exhibits to melodramatic poetry readings. There are numerous websites that allow you to test yourself on this dimension. However, while these types of characters undoubtedly exist, the degree to which these personalities are linked to different hemispheres is very limited. In fact, neuroimaging studies of personality traits show that characteristics similar to left- and right-brained people (as measured by the pseudoscientific tests) are distributed across both hemispheres (DeYoung et al., 2010).

The Changing Brain

Listen to the Audio

When people first encounter information about the brain's anatomy, there is often a tendency to think of it as being permanent. However, the opposite is true. The strength of the connections between brain structures —and even the volume (size) of some brain areas themselves—can change as a result of our experiences.

Neuroplasticity

Listen to the Audio

In Module 3.2, you read about *stem cells*, immature cells whose final role—be it a neuron or a kidney cell—is based on the chemical environment in which it develops. In other words, the cell's experience (its environment) influenced its physical structure. While fully formed neurons will never have this type of flexibility, brain cells do have a remarkable property called **neuroplasticity**—*the capacity of the brain to change and rewire itself based on individual experience*. For example, numerous studies have shown that the occipital lobes of people who are blind are used for non-visual purposes (Pascual-Leone et al., 2005). This plasticity was beautifully demonstrated in a brain-imaging study using healthy individuals. All participants underwent brain imaging to determine the areas that became active when they performed tasks related to hearing and touch; during this initial phase, the occipital lobes—a region associated with vision—were not active. These participants were then blindfolded for five days before being scanned again. During the second scan session, brain areas normally dedicated to vision became active during touch and hearing tasks (Pascual-Leone & Hamilton, 2001).

Watch The Plastic Brain

There are numerous other examples of neuroplasticity. For example, experienced musicians develop a greater density of grey matter in the areas of the motor cortex of the frontal lobe as well as in the auditory cortex (Gaser & Schlaug, 2003). Studies of children have found that individuals who practised an instrument regularly for over two years had a thicker corpus callosum in areas connecting the left and right frontal and temporal lobes (Schlaug et al., 2009). Even a seemingly silly skill like learning to juggle can influence the thickness of white-matter pathways connecting different brain areas (Scholz et al., 2009). The key point in all of these studies is that although genetics controls *some* of your brain's characteristics, your brain's connections are not set in stone. What you *do* with (and to) your brain can have a dramatic effect on your brain's connections and thus how your brain functions.

#Psych

Action Videos Games and Neuroplasticity

Action video games (AVGs) such as *Fortnite* and *Assassin's Creed* have become incredibly popular in recent years. It is estimated that the world's population spends over three *billion* hours per week playing AVGs (Zimbardo & Duncan, 2012). In the past decade, psychologists have started to examine the effects that these games have on our cognitive and perceptual abilities. These studies have shown that AVGs actually improve

a person’s attentional abilities as well as their hand-eye coordination and response speeds (Bavelier et al., 2012; Kennedy et al., 2011). These results make sense given that AVGs are perceptually demanding.

But could playing these games actually change pathways in the brain? Recent research suggests that they can. A recent study found that avid AVG players had more connections between occipital and parietal lobe areas than non-AVG players (Kowalczyk et al., 2018). These brain areas are involved with vision and attentional functions. Other studies have found changes in white-matter pathways in the frontal lobes and sensorimotor areas of the brain (Gong et al., 2017), as well as increased sensitivity of pathways linking movement areas of the brain with the spinal cord (Morin-Moncet et al., 2016). AVGs can also lead to an increase in grey matter in the hippocampus if the games require players to use spatial strategies such as remembering locations (West et al., 2018). Together, these data suggest that playing AVGs can have *some* beneficial effects on a person’s brain. More importantly, these data show us that neuroscience isn’t limited to a laboratory or a textbook. Neuroscience affects, and is affected by, everything we do.

As you can see, the plastic nature of our brain′s connections can explain a number of interesting phenomena ranging from improvements in guitar skills to video game performance. But neuroplasticity is also important for individuals who are attempting to recover from brain injuries.

Working the Scientific Literacy Model

Neuroplasticity and Recovery from Brain Injury

Listen to the Audio

The fact that neuroplasticity exists makes it seem like recovery from brain damage should be easy—the remaining brain areas should simply rewire themselves to take over the functions of the damaged brain areas. However, it's not that simple—and we are lucky it isn't.

What do we know about neuroplasticity?

Some animals with relatively simple brains and spinal cords, such as fish and some amphibians, have a lifelong ability to regenerate damaged areas of their central nervous system. If members of these species suffer a brain or spinal cord injury, they will automatically create new tissue to replace the damaged nerves (Sperry, 1951, 1956, 1963, 1968). Humans can do this to a limited degree in the peripheral nervous system as well. This is because chemicals called **trophic factors** (growth factors) *can stimulate the growth of new dendrites and axons*. However, the ability of the human brain to recover from damage is more limited. New neurons can form in adulthood, but only in a few regions such as part of the hippocampus (Eriksson et al., 1998). That means we can't simply grow a new brain part whenever we're injured.

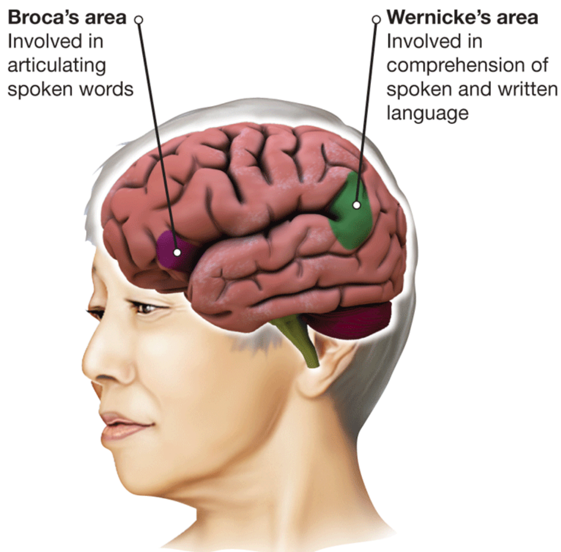
Our ability to repair our brains is also limited by the presence of chemicals that actually *inhibit* the growth of new axons around an injured area (Yang & Schnarr, 2008). Why would this occur? Researchers suggest that these inhibitory chemicals prevent the brain from forming incorrect connections between brain areas, a result that might produce even larger behavioural problems than the initial damage itself (Berlucchi, 2011; Kolb et al., 2010). So, if our central nervous system is protecting us against neuroplasticity, how can neuroplasticity be the key to recovering from brain damage?

How can science explain how neuroplasticity contributes to recovery from brain damage?

Although it seems like the brain is preventing its own recovery, there are actually a number of ways that neuroplasticity can work to help patients with brain damage. One possibility is that the same area in the opposite hemisphere will take over some of the functions of the damaged region. Stunning evidence of this phenomenon has been found in studies of Melodic Intonation Therapy (MIT; Norton et al., 2009). Researchers have found that some patients with damage to Broca's area—a part of the left frontal lobe involved with the production of speech—can actually sing using fluent, articulated words, even though they cannot speak those same words (see Figure 3.30). In a study of this technique, patients who had suffered strokes affecting Broca's area underwent intensive MIT sessions. During these sessions the patients would sing long strings of words using just two pitches, while rhythmically tapping their left hand to the melody. The patients underwent 80 or more sessions lasting 1.5 hours each day, five days per week. Remarkably, this therapy has worked for multiple patients—after these intensive therapy sessions, they typically regain significant language function (Schlaug et al.,

2009). The therapy does not "heal" damaged nerve cells in the left hemisphere at Broca's area. Rather, language function is taken over by the corresponding area of the *right* hemisphere.

Figure 3.30 Brain Specialization



Broca's area and Wernicke's area are associated with different aspects of language function. Damage to Broca's area produces difficulties in generating speech known as *Broca's aphasia*.

Another method that the brain uses to repair itself is the reorganization of neighbouring neural regions. In healthy brains, the distinction between most brain areas is not as clear-cut as it appears on textbook diagrams. For instance, it is common for parts of the somatosensory cortex related to the hand to overlap a bit with regions related to the wrist. If one of those somatosensory areas were damaged, there might still be a small number of neurons associated with that body part preserved in other parts of the nearby cortex. When the brain is damaged, it is thought that these preserved neurons attempt to form new

connections. Doing so would allow some sensation to return. This process is enhanced if the doctors force the patient to use the affected brain area as much as possible during rehabilitation (Mark et al., 2006). Although it seems cruel, patients must remember to "use it or lose it."

Can we critically evaluate this research?

There are obviously limits to the effects of neuroplasticity. If a patient has damage to a large amount of their brain, it will not be possible for them to return to their normal level of functioning. Additionally, plasticity is more likely to be effective in younger people, particularly children, than in older adults (Kennard, 1942). Therefore, it is important not to over-generalize the results just discussed. It is also possible that results that seem to be due to neuroplasticity are actually due to some other factor, such as changes in hormone levels, the brain's metabolism, or growth factor levels (Knaepen et al., 2010; Sperry, 1968). Although all of these alternative explanations have been tested to some degree in animal studies, it is sometimes difficult to generalize those findings to the human brain. Therefore, much more research is needed before researchers can make any definitive statements about how neuroplasticity helps brain-damaged patients recover.

Why is this relevant?

Each year, 40 000 to 50 000 Canadians suffer strokes (Heart and Stroke Foundation of Canada, 2013) and over 160 000 suffer traumatic brain injuries (e.g., car accidents; Brain Injury Canada, 2016). Over 55 000 Canadians are living with brain tumours (Brain Tumour Foundation of Canada, 2013). Neuroplasticity will occur, to some degree, in the majority of these individuals. It is what will help people regain some of their abilities and some of their independence. Understanding neuroplasticity will improve the care given to patients. It will also inspire new research and

innovative techniques designed to help the brain heal itself (Kim et al., 2010). This research may affect your grandparents or your parents. And eventually, this research may affect you.

Module 3.3 Summary

Listen to the Audio

3.3a Know . . . the key terminology associated with the structure and organization of the nervous system.

Review Module 3.3

Start Over Swap

0/31 REVIEWED · 0 MASTERED

peripheral nervous system (PNS)

Previous Next Got It!

3.3b Understand . . . how studies of split-brain patients reveal the workings of the brain.

Studies of split-brain patients were important in that they revealed that the two hemispheres of the brain are specialized for certain cognitive

tasks. For example, studies of split-brain patients showed that the left hemisphere was specialized for language. These studies were carried out before other brain-imaging techniques (see Module 3.4) became available.

3.3c Apply . . . your knowledge of brain regions to predict which abilities might be affected when a specific area is injured or diseased.

Apply Activity

Apply Activity Matching Clinical Descriptions and Brain Areas

Review Table 3.5, which summarizes each of the major brain regions described in this module. Then try to match the following descriptions with the affected brain areas.

Clinical Description	Affected Brain Area
While at work, a woman suffers a severe blow to the back of her head and then experiences visual problems.	Occipital lobe
An individual has a stroke and loses the ability to produce speech in clear sentences.	Broca's area
An individual suffers a head injury and now has problems timing his movements and controlling his emotional responses.	Cerebellum
A patient experiences brain damage and is now unable to form new memories.	Hippocampus

Check Your Understanding

3.3d Analyze . . . whether neuroplasticity will help patients with brain damage.

There are many examples of experience changing the structure of the brain. Research suggests that neuroplasticity can also help people recover from brain damage. If the damage is isolated to one cerebral hemisphere,

cells in the same region of the opposite hemisphere may be able to take over some of the impaired functions. Additionally, it is possible that some of the cells involved with a function (e.g., sensation of the hand) were undamaged; these remaining cells may form new, stronger connections over the course of rehabilitation.

Module 3.4 Windows to the Brain: Measuring and Observing Brain Activity

Listen to the Audio

Frank Gunn/AP/Shutterstock

Learning Objectives

3.4a Know . . . the key terminology associated with measuring and observing brain activity.

3.4b Understand . . . how studies of animals with brain lesions can inform us about the workings of the brain.

3.4c Apply . . . your knowledge of neuroimaging techniques to see which ones would be most useful in answering a specific research question.

3.4d Analyze . . . whether neuroimaging can be used to diagnose brain injuries.

On December 1, 2018, boxer Adonis Stevenson stepped into the boxing ring at the Videotron Centre in Quebec City. The 41-year-old Haitian-Canadian had an impressive record: 29 wins (including 24 knockouts), one loss, and one draw. His opponent that night was Oleksandr Gvozdyk, a 31-year-old Ukrainian fighter with a perfect 15-0 record. The night started well for Stevenson. Through the first ten rounds of the 12-round fight, he was leading on two of the three judges' scoring cards and was tied on the other. He just needed to get through the final six minutes of the bout. However, late in the 11th round, Gvozdyk stunned Stevenson with a powerful shot and then unleashed a 10-punch flurry that left Stevenson on the canvas, barely aware of his surroundings. Stevenson was helped to the dressing room but soon collapsed and was rushed to a Quebec City hospital. The doctors performed surgery on his brain and placed him into a medically induced coma for three weeks. Although Stevenson did eventually regain consciousness, the doctors

told the media that these types of severe brain injuries can have lasting effects on a patient's cognitive abilities, identifying several of them with great confidence. Stevenson's boxing career is likely finished.

Injuries such as Stevenson's lead to a number of questions for people interested in the biology of behaviour: How can psychologists and medical personnel acquire clear images of a person's brain? How can surgeons make predictions about how the brain damage will affect specific abilities? And, can scientists learn anything about the healthy brain by studying patients like Stevenson who have suffered brain damage? These topics will be addressed in the current module.

In Module 3.3, you read about different brain areas and their functions. This leads to an obvious question: How did researchers find out what these brains areas do? In this module, we will examine the different methods and tools available to physicians and researchers in their quest to map out the functions of different brain areas.

Insights from Brain Damage

Listen to the Audio

Early studies of the brain often involved case studies. A doctor would note a patient's unique set of symptoms and would then ghoulishly wait for them to die so that an autopsy could be performed in order to identify the damaged area. As medical knowledge improved, surgeons began to routinely operate on the brains of patients with neurological problems. This allowed researchers to examine patients before and after brain surgery to see the effect that removing tissue would have on behaviour. However, in each of these cases, insights into the brain were based on individuals who had suffered some sort of trauma or illness. There was no way to test how healthy brains functioned. In the past four decades, advances in brain imaging have changed this, and have allowed researchers to safely measure the brain's activity.

This is not to say that studying patients with brain damage is not scientifically useful. In fact, quite the opposite is true. The only way researchers can truly hope to understand how the brain works is by using a number of methods to assess its function.

Lesioning the Brain

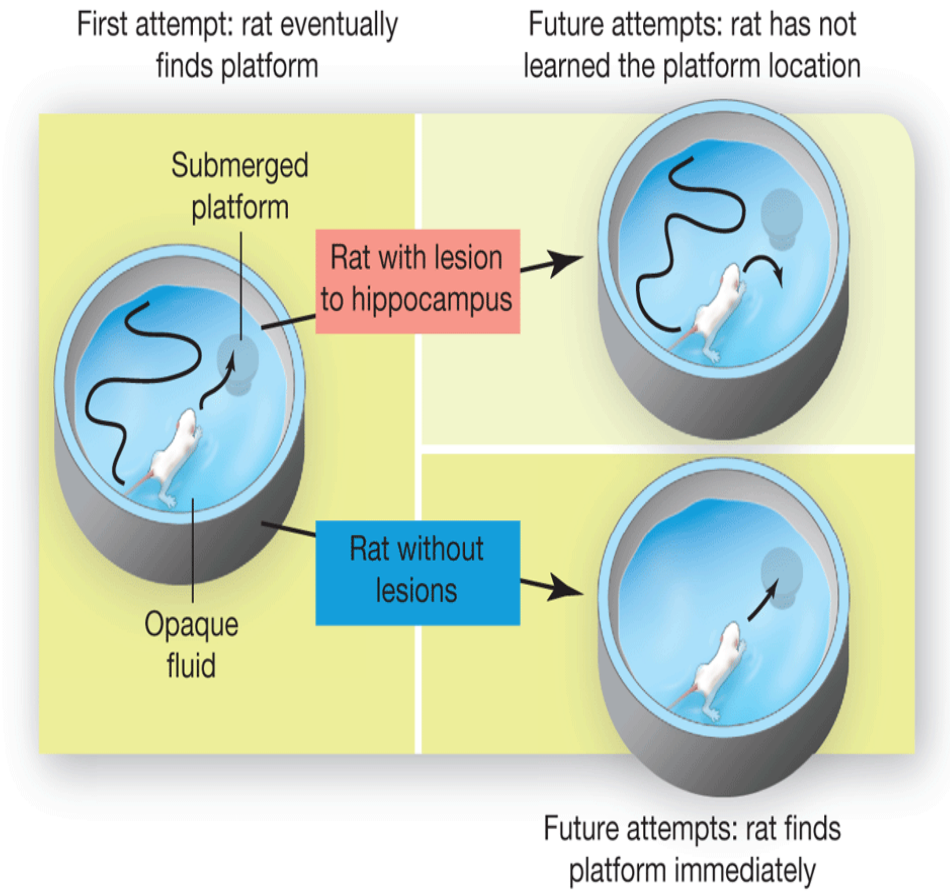
Listen to the Audio

Studies of patients who have suffered brain damage will appear in a number of modules in this text. The logic of this method is that if a person has part of their brain damaged and is unable to perform a particular task (e.g., form new memories), then it is assumed that the damaged structure plays a role in that behaviour. One drawback of studying human patients, however, is that the researcher has no control over where the damage occurs. A stroke generally produces widespread damage; rarely will it harm a single area while leaving the rest of the brain totally unaffected. This diffuse damage makes it difficult for brain researchers to perform controlled studies of patients—each patient will have a unique pattern of damage. It is also difficult to isolate the effects of damage to one brain area when several are affected.

In order to gain more experimental control (and a much larger number of subjects), scientists often create brain damage in animals. This process is known as **lesioning**, *a technique in which researchers intentionally damage an area in the brain* (a *lesion* is abnormal or damaged brain tissue). Creating lesions allows researchers to isolate single brain structures. They can then study animals with and without lesions to see how specific behaviours are changed by the removal of that brain tissue. The control subjects are often part of a **sham group**, *a set of animals that go through all of the surgical procedures aside from the lesion itself in order to control for the effects of stress, anesthesia, and the annoyance of stitches*. An example of the lesion method is found in studies of spatial learning. Researchers

hypothesized that the hippocampus was vital for this ability. In order to test this hypothesis, the researchers lesioned the hippocampus on both sides of the brains of one group of rats and performed sham surgery on the other rats. Each rat was then put into the Morris Water Maze (Morris, 1981); this device consists of a container filled with an opaque (non-transparent) fluid (see Figure 3.31). The rat is placed in the water and must swim around until it finds a small platform hidden under the fluid. At first, the rat finds the platform by chance; over time, the rat learns the location of the platform and swims to it immediately. However, rats with lesions to the hippocampus show a marked impairment in learning the location of the platform, presumably because the hippocampus is critical for many spatial abilities (Morris et al., 1982). This example demonstrates the power of the lesion method to determine the roles played by specific brain areas.

Figure 3.31 The Morris Water Maze



Tools like the Morris Water Maze allow researchers to test the effects of brain lesions on behaviours such as spatial memory.

Brain Stimulation Studies

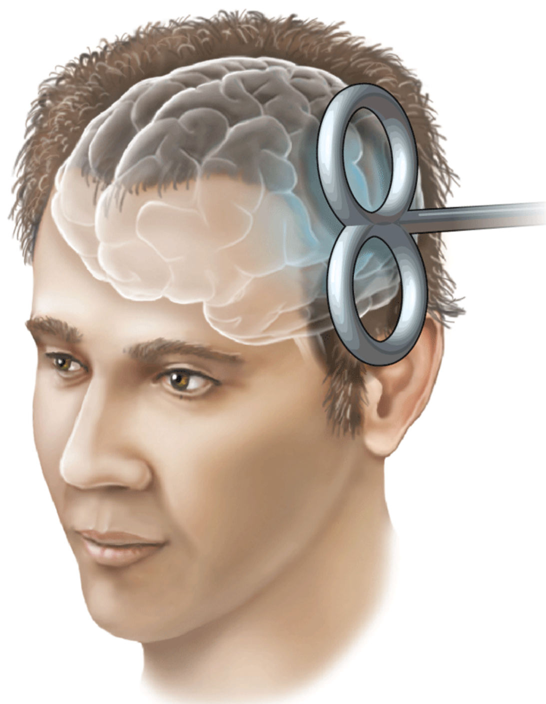
Listen to the Audio

Less drastic techniques impair brain activity only temporarily; in fact, some can be safely applied to humans. For instance, researchers can study brain functions using **transcranial magnetic stimulation (TMS)**, *a procedure in which an electromagnetic pulse is delivered to a targeted region of the brain* (Bestmann, 2008; Terao & Ugawa, 2002). This pulse interacts with the flow of ions around the neurons of the affected area. The result is a temporary disruption of brain activity, similar to the permanent disruption caused by a brain lesion. This procedure has the advantage that healthy human volunteers can be studied (as opposed to animals or brain-damaged people, many of whom are elderly). TMS has been used to investigate a number of cognitive processes ranging from visual perception (Perini et al., 2012) to arithmetic abilities (Andres et al., 2011) to memory for words and abstract shapes (Floel et al., 2004). In each case, impairments in performance after receiving the TMS "temporary lesion" tell the researcher that the stimulated brain area is likely involved in that cognitive process.

Interestingly, if a weaker electromagnetic pulse is delivered, TMS can also be used to stimulate, rather than temporarily impair, a brain region (Figure 3.32). For example, TMS has been used to increase the activity in the frontal lobes—an area related to planning and inhibiting behaviour—when people were performing a gambling task. This change led the participants to behave in a more cautious, risk-averse manner than when they performed the task without this stimulation (Fecteau, Pascual-Leone

et al., 2007). TMS has also been used to stimulate under-active areas associated with depression, suggesting that this tool has clinical applications as well (Kluger & Triggs, 2007). In fact, researchers have used this technique to help patients deal with symptoms of disorders ranging from Parkinson's disease (Degardin et al., 2012) to movement problems caused by strokes (Corti et al., 2012; Schlaug et al., 2008).

Figure 3.32 Brain Stimulation



Transcranial magnetic stimulation involves targeting a magnetic field to a very specific region of the brain. Depending on the amount of stimulation, researchers can temporarily either stimulate or disable the region.

Although lesion work and TMS allow researchers to understand what happens to the brain when certain regions are removed or inactive, these methods don't provide a picture of the brain's structures or its patterns of

activity. Luckily, there have been astonishing advances in neuroimaging over the past 40 years.

Structural and Functional Neuroimaging

Listen to the Audio

Neuroimaging (or brain imaging) is becoming increasingly important for many fields, particularly for psychology. Being able to examine the brains of living people and to measure neural activity while participants perform different tasks provides an astonishing window into the mind. Neuroimaging has also revolutionized medicine, allowing doctors to see with great precision the size and location of brain injuries. The remainder of this module will focus on the two types of brain scanning: structural and functional neuroimaging.

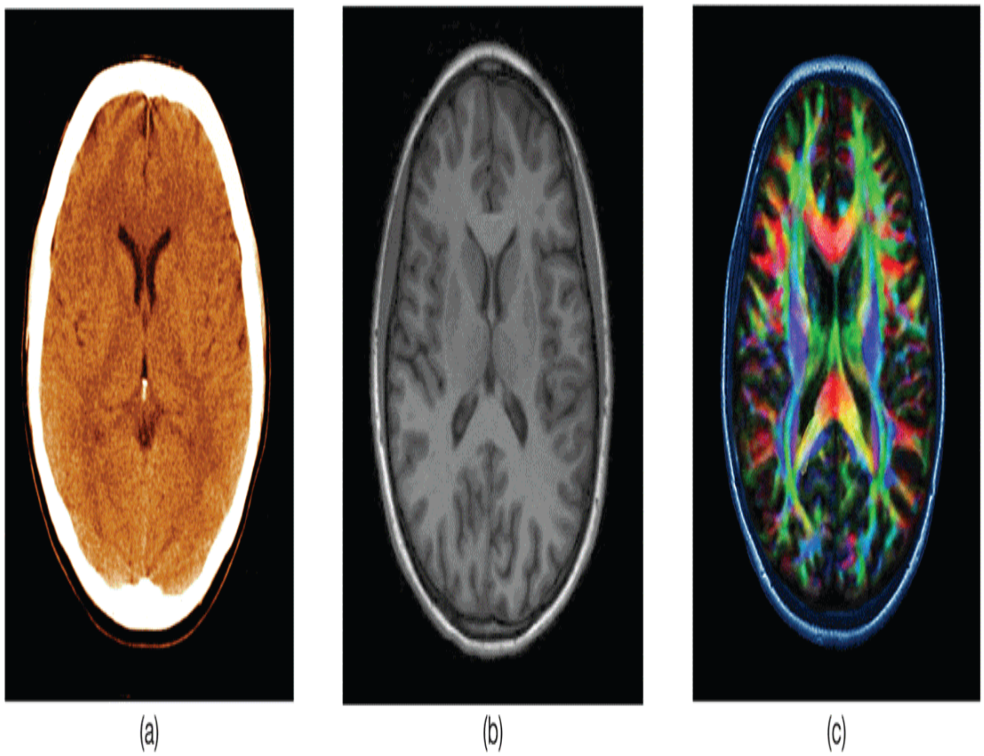
Structural Neuroimaging

Listen to the Audio

At the beginning of this module, you read about boxer Adonis Stevenson's brutal knockout loss and the fact that he needed to be hospitalized for several weeks after being knocked out. When Stevenson first arrived at the hospital, the doctors would obviously have wanted to determine the extent of the damage to his brain. In order to get this information, it was necessary to use **structural neuroimaging**, *a type of brain scanning that produces images of the different structures of the brain*. This type of neuroimaging is used to measure the size of different brain areas and to determine whether any brain injury has occurred.

There are three commonly used types of structural neuroimaging. **Computerized tomography** (or **CT scan**) *is a structural neuroimaging technique in which x-rays are sent through the brain by a tube that rotates around the head*. The x-rays will pass through dense tissue (e.g., grey matter) at a different speed than they will pass through less dense tissue, like the fluid in the ventricles (Hounsfield, 1980). A computer then calculates these differences for each image that is taken as the tube moves around the head and combines that information into a three-dimensional image (see Figure 3.33). As an interesting historical aside, the first commercial CT scanner was created in the early 1970s by EMI (and was called the EMI-Scanner), a company also involved in the music industry. This company had enough money to pay for four years of medical-imaging research because they were also the record label of a band known as The Beatles (Filler, 2009).

Figure 3.33 Structural Neuroimaging



Three different types of structural neuroimaging: (a) a CT scan, (b) an MRI scan, and (c) a diffusion tensor imaging scan.

Left: Guy Croft SciTech/Alamy Stock Photo; middle: Steve Smith; right: Zephyr/Photo Researchers, Inc./Science Source

CT scans were considered state-of-the-art for over a decade. However, in the 1970s and early 1980s, a new form of structural neuroimaging emerged. **Magnetic resonance imaging** (or **MRI**) *is a structural imaging technique in which clear images of the brain are created based on how different neural regions absorb and release energy while in a magnetic field*. Although this sounds confusing, understanding MRIs involves three steps. First, a brain (or other body part) is placed inside a strong magnetic field; this causes the protons of the brain's hydrogen atoms to spin in the same direction. Second, a pulse of radio waves is sent through the brain; the energy of this pulse is absorbed by the atoms in the brain and knocks them out of their previous position (aligned with the magnetic field).

Finally, the pulse of radio waves is turned off. At this point, the atoms again become aligned with the magnetic field. But, as they do so, they release the energy they absorbed during the pulse. Different types of tissue—grey matter, white matter, and fluid—release different amounts of energy and return to their magnetic alignment at different speeds. Computers are used to calculate these differences and provide a very detailed three-dimensional image of the brain (Huettel et al., 2009).

As you can see from Figure 3.33, MRIs produce much clearer images than CT scans and are more accurate at detecting many forms of damage, including severe concussions like that suffered by Adonis Stevenson (Bazarian et al., 2007). So, why are CT scanners still used? Let's go back to Stevenson's injury. He was hit repeatedly by leather boxing gloves and the fell to the canvas mat with his head lying on the nylon ropes, so the chances of him having metal in his brain were quite slim. But what if a person entered the hospital after a car accident? He might have fragments of metal in his body; these would not react well to a powerful magnet. Therefore, CT scans, aside from being cheap, are a safe first-assessment tool for brain injuries. When the doctors have more information about the patient and his injury, then it is possible that the more accurate MRI will be used.

A final type of structural neuroimaging technique is also the newest. **Diffusion tensor imaging** (or **DTI**) *is a form of structural neuroimaging allowing researchers or medical personnel to measure white-matter pathways in the brain*. Although it is natural to assume that the grey matter—the cell bodies—is the most sensitive part of the brain, white-matter damage has been found in an increasing number of brain disorders (Shenton et al., 2012). This is because most head injuries cause the brain to twist around in the skull. The result is that some of the white-matter pathways connecting different brain areas are torn. A large number of studies have shown that these pathways are damaged in individuals who have suffered

concussions (Niogi & Mukherjee, 2010), although it is unclear whether professional and collegiate/university sports leagues are using this technology when making return-to-play decisions for injured athletes (J. K. Johnson et al., 2012).

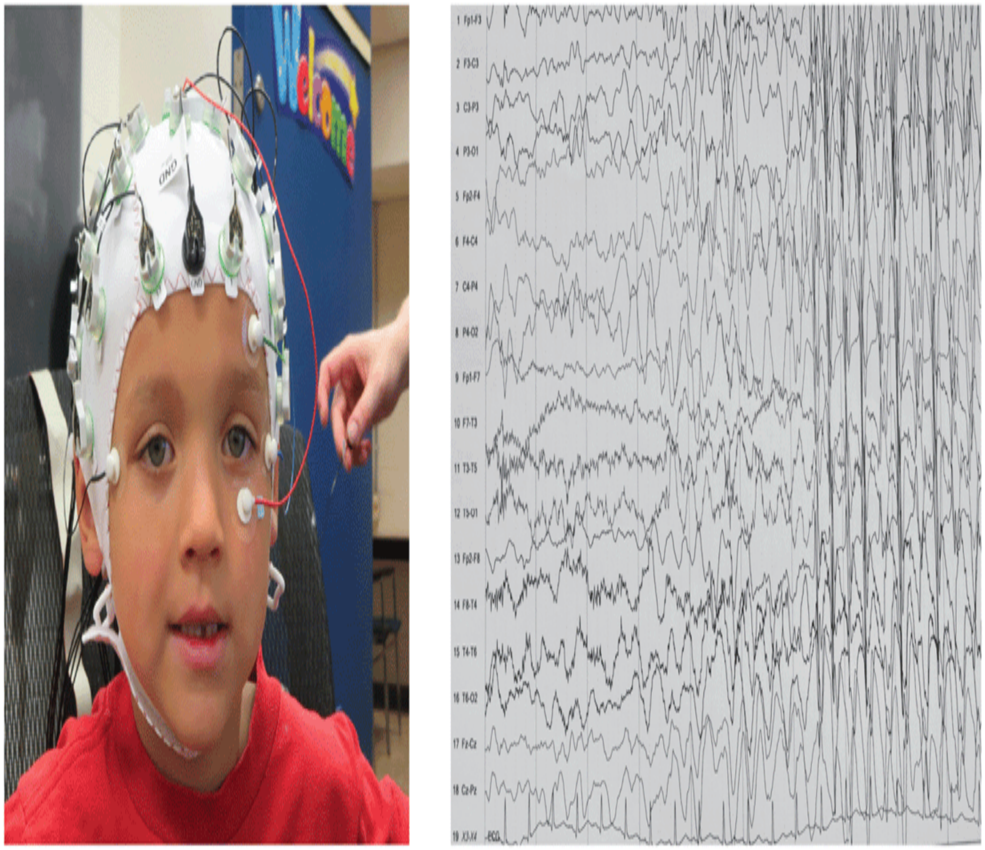
Functional Neuroimaging

Listen to the Audio

Although structural images provide useful information about the brain's anatomy, they do not tell us much about the functions of those brain areas. This information is gathered using **functional neuroimaging**, *a type of brain scanning that provides information about which areas of the brain are active when a person performs a particular behaviour*. There are a number of different functional neuroimaging methods available to researchers and physicians. A common trade-off is between *temporal resolution* (how brief a period of time can be accurately measured) and *spatial resolution* (a clear picture of the brain). Which tool is used depends upon the type of question being asked.

A neuroimaging method with fantastic temporal resolution is an **electroencephalogram** (or **EEG**), *which measures patterns of brain activity with the use of multiple electrodes attached to the scalp*. The neural firing of the billions of cells in the brain can be detected with these electrodes, amplified, and depicted in an electroencephalogram. EEGs measure this activity every millisecond. They can tell us a lot about general brain activity during sleep, during wakefulness, and while patients or research participants are engaged in a particular cognitive activity. EEGs are also used to detect when patients with epilepsy are having a seizure; this would be shown by a sudden spike in activity (neuronal firing) in one or more brain areas (see Figure 3.34). The convenience and relatively inexpensive nature of EEGs, compared to other modern methods, make them very appealing to researchers.

Figure 3.34 Measuring Brain Activity



The electroencephalogram measures electrical activity of the brain by way of electrodes that amplify the signals emitted by active regions (left). In clinical conditions such as epilepsy (right), specific EEG measurements will spike. This provides the medical team with information about the origin of the seizure.

Steve Smith, Chaikom/Shutterstock
From Figure 2 in Role of EEG in Epilepsy Syndromes in EEG of Common Epilepsy Syndromes by Raj D Sheth, MD. Copyright © 2016 by Raj D Sheth. Used by permission of Medscape LLC.

But how can EEG be used to further our understanding of human behaviour? In most studies, researchers would be interested in how brain responses differ for different types of stimuli, such as happy or fearful faces. EEGs have perfect temporal resolution for this task, but they have a problem: How do you link the EEG output (a bunch of squiggly lines)

with your stimuli? To do this, researchers have developed a technique known as *event-related potentials* (or ERPs). ERPs use the same sensors as EEGs; however, a computer takes note of exactly when a given stimulus (e.g., a smiling face) was presented to the participant. The experimenter can then examine the EEG readout for a brief period of time (usually 1 to 2 seconds) following the appearance of that stimulus. Importantly, the computer can collect the average brain responses for different types of experimental trials. So, if an experiment contained 50 separate stimulus presentations—25 happy faces and 25 fearful faces—the experimenter could collect the *average* pattern of data after each type of stimulus (i.e., there would be one set of squiggly lines for happy faces and one for fearful faces).

Critically, the peaks and valleys of these *waveforms* are not random—each is associated with some sort of process occurring in the brain. For example, initial detection of some sort of visual image could occur after 80–120 ms (Mangun et al., 1993). Determining that the image was a face might occur at approximately 170 ms (Bötzel et al., 1995). And identifying that face as someone you know might occur sometime after 300 ms. Researchers can then look at the size of the peaks and valleys to determine whether there was a difference in the amount of brain activity in response to the different stimulus types (e.g., a peak at 200 ms was higher for fearful than for happy faces). This technique can also have clinical uses. If a patient (e.g., someone with multiple sclerosis) was missing an expected waveform, the neurologist could conclude that a particular region of the brain was not functioning normally (Ruseckaite et al., 2005).

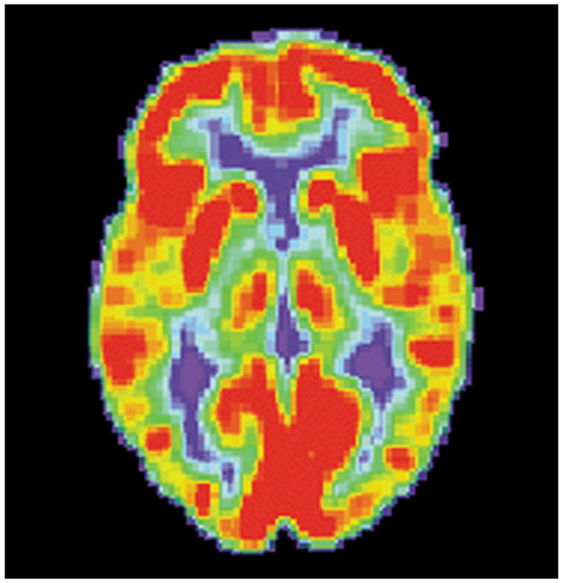
Although ERPs are very useful for measuring *when* brain activity is occurring, they are much less effective at identifying exactly *where* that activity is taking place. Part of this problem is due to the fact that the skull disrupts the electrical signal from the neurons' firing; this reduces the

accuracy of ERP measurements. In order to get around this, some researchers measure the magnetic activity associated with cells firing. This is accomplished by using **magnetoencephalography** (or **MEG**), *a neuroimaging technique that measures the tiny magnetic fields created by the electrical activity of nerve cells in the brain*. Like EEG, MEG records the electrical activity of nerve cells just a few milliseconds after it occurs, which allows researchers to record brain activity at nearly the instant a stimulus is presented (Hamalainen et al., 1993). In a study with happy and fearful faces, MEG could measure when an image was detected and when it was recognized as being a face (Halgren et al., 2000). However, like ERPs, this speed comes with a trade-off; namely, MEGs do not provide a detailed picture of the activity of specific brain areas. So, although its ability to isolate the location of brain activity is slightly better than that of ERPs, it is still difficult to isolate exactly *where* in the brain the activity occurred.

A functional imaging method that *can* show activity of the whole brain is **positron emission tomography** (or **PET**), *a type of scan in which a low level of a radioactive isotope is injected into the blood, and its movement to regions of the brain engaged in a particular task is measured* (Figure 3.35). This method works under the assumption that active nerve cells use up energy at a faster rate than do cells that are less active. As a result, more blood will need to flow into those active areas in order to bring more oxygen and glucose to the cells. If the blood contains a radioactive isotope (as in a PET study), more radioactivity will be detected in areas of the brain that were active during that period of time. In most studies, participants will complete separate blocks of trials or even separate scanning sessions for different types of experimental trials. The activity from these sessions is then compared to see which brain areas are more (or less) active in response to different types of stimuli. For instance, researchers at McGill University provided the first evidence that the

ventral (bottom) portions of the right hemisphere of the brain were involved with recognizing faces (Sergent et al., 1992).

Figure 3.35 Positron Emission Tomography



PET scans use radioactive isotopes to help identify which areas of the brain were most active.

Photo Researchers, Inc./Science Source

The greatest strength of PET scans is that they show metabolic activity of the brain. PET also allows researchers to measure the involvement of specific types of receptors (e.g., types of dopamine receptors) in different brain regions while people perform an experimental task (e.g., Woodward et al., 2009). A drawback is that PET scans take a long time to acquire—at least two minutes—which is a problem when you want to see moment-by-moment activity of the brain. The radioactivity of PET also generally limits the participants to men because it is possible that female participants could be in the early stages of pregnancy. In that case, the risks of participating would far outweigh the rewards. Instead, researchers are increasingly turning to a powerful neuroimaging technique with excellent spatial resolution.

Working the Scientific Literacy Model

Functional MRI and Behaviour

Listen to the Audio

Functional magnetic resonance imaging (or **fMRI**) *measures brain activity by detecting the influx of oxygen-rich blood into neural areas that were just active* (Kwong et al., 1992; Ogawa et al., 1992). Like PET scanning, fMRI can produce an accurate image of the functional brain. However, its ease of use (and lack of radioactivity) has quickly made it one of the most influential research tools in modern psychology.

What do we know about fMRI and Behaviour?

If you type in "fMRI" into the PubMed.gov research database, you will see that there have been over half a million papers published since this technology was developed 25 years ago. The growth in this field is staggering—there are literally thousands of fMRI research papers published each year. Researchers are using fMRI to study almost every topic discussed in this text, ranging from sensory processes (Chapter 4) to memory (Chapter 7) to social behaviours (Chapter 13). Importantly, fMRI is also being used to examine clinical issues including psychological disorders (Chapter 15) and disorders of consciousness (e.g., vegetative states, Module 5.3). It is also being used to examine brain activity in neurological patients like Adonis Stevenson—psychologists and medical personnel can look at what areas of

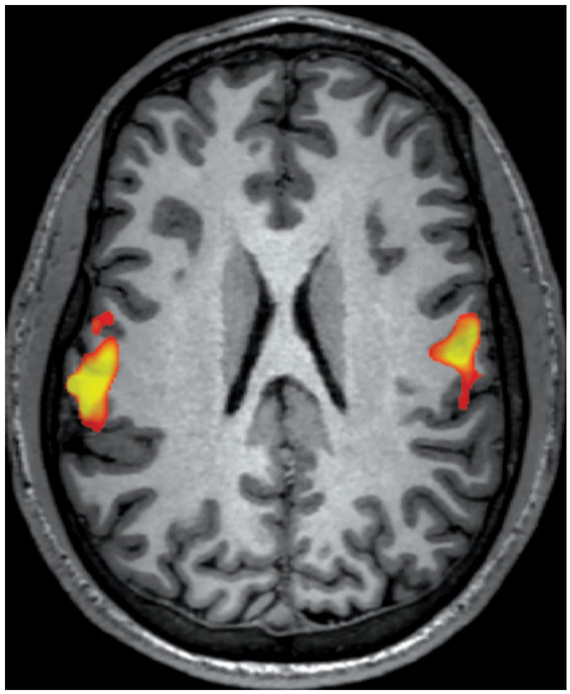
the brain are active when a person is performing different tasks such as remembering lists of words. If the patterns of activity deviate from those of healthy individuals, then the investigators can infer that specific brain regions are not working properly. With this surge in fMRI research and clinical use, it is important to examine *how* fMRI links blood flow to descriptions of behaviour.

How can science explain fMRI's use in psychology and neuroscience?

When a brain area is involved with a particular function, it will use up oxygen. The result is that blood in these areas will be deoxygenated (without oxygen molecules). The body responds by sending in more oxygen-rich blood to replace the deoxygenated blood. Critically, these two types of blood have different magnetic properties. So, by measuring the changing magnetic properties of the blood in different brain areas, it is possible to see which areas were active when the person performed a particular task (Huettel et al., 2009; Magri et al., 2012). When you see pictures of different brain areas "lit up," those colourful areas indicate that more activity occurred in that location during one experimental condition than during another (see Figure 3.36). To continue our example of perceiving faces, researchers could present happy or fearful faces to participants while they were in the fMRI scanner (which is the same machine used for structural MRI scans). After the study, the researchers could look at the average amount of brain activity that occurred when each participant viewed each type of face. In this case, seeing faces would activate a region in the bottom of the right hemisphere known as the *fusiform gyrus* (Kanwisher et al., 1997; see Module 4.2). Faces expressing fear also would activate the amygdala, and faces expressing happiness activate a wide

network of structures in the frontal lobes (M. L. Phillips et al., 1998). Thus, fMRI provides very detailed images of *where* brain activity is occurring. Unfortunately, it can only measure activity at the level of seconds rather than milliseconds; therefore, it lacks the temporal resolution of ERP and MEG (see Table 3.6).

Figure 3.36 Functional Magnetic Resonance Imaging



Functional MRI technology allows researchers to determine how blood flow, and hence brain activity, changes as study participants or patients perform different tasks. In this image, the coloured areas depict increases in blood flow to the left and right temporal lobes, relative to the rest of the brain, during a cognitive task.

Living Art Enterprises/Science Source

Table 3.6 Common Methods of Functional Neuroimaging

Table 3.6 Common Methods of Functional Neuroimaging

Neuroimaging Method	Advantages	Disadvantages
EEG/ERP	Excellent temporal resolution (measures activity at the millisecond level); inexpensive	Poor spatial resolution (does not give a picture of individual brain structures)
MEG	Excellent temporal resolution (measures activity at the millisecond level)	Poor spatial resolution (does not give a picture of individual brain structures)
PET	Provides a picture of the whole brain (although not as clear as fMRI); allows researchers to examine activity related to specific neurotransmitters (e.g., dopamine)	Very poor temporal resolution (takes at least two minutes to scan the brain, often longer); involves radioactive isotopes that limit possible participants; very expensive
fMRI	Excellent spatial resolution (clear images of brain structures)	Temporal resolution is not as good as ERP or MEG (it takes approximately two seconds to scan the whole brain)

Can we critically evaluate this research?

Although researchers have shown that the activity that we see in fMRI images is actually linked to the firing of neurons (Logothetis et al., 2001), we still need to be cautious when interpreting fMRI data. One reason is that it is correlational in nature. Activity increases or decreases at the same time as different stimuli are perceived; however, we can't definitively show that the activity was *caused* by the stimuli. Also, just because a brain area is *active* while we perform a task does not mean that it is *necessary* for that task. It is possible that a given area that "lights up" on fMRI is a small part of a larger network, or performs a supporting role. Therefore, it is useful to look at research using other methods (if available) to see if similar brain areas were implicated in a given behaviour.

There is an additional reason to be cautious of fMRI data. There is a growing trend for neuroimaging, particularly fMRI, to be used to explain or justify phenomena that are not easily measured (Satel & Lilienfeld, 2013). Images of brains with areas lit up can

be found on almost every major online news site. The problem is that many of the claims made in these stories are overstated (more likely, but not always, by the media than by the scientists). Given the massive connections between brain areas, headlines that suggest that scientists have discovered the “hate centre” or *the* neural structure associated with how someone will vote are misleading. Most brain areas are activated by *many* different situations and stimuli. So, just as you would raise your skeptical eyebrows in response to reports of scientists finding the single gene for a given behaviour (see Module 3.1), you should apply your critical-thinking skills toward claims about scientists identifying the single brain area for any complex process.

Why is this relevant?

It is difficult to overstate how important fMRI has been to psychological science. It has allowed researchers to map out the networks associated with a huge range of topics, thus providing most of the “bio” components of the biopsychosocial model of behaviour. Recently, researchers at Queen’s University and the University of Manitoba have found ways to perform fMRI on neurons in the spinal cord (Kornelsen et al., 2013; Stroman, 2005). Thus, it will soon be possible to measure how the *entire* central nervous system responds to different stimuli, an ability that will allow us to gain a more complete understanding of human behaviour.

Module 3.4 Summary

Listen to the Audio

3.4a Know . . . the key terminology associated with measuring and observing brain activity.

Review Module 3.4

Start Over Swap

0/12 REVIEWED · 0 MASTERED

functional neuroimaging

Previous Next Got It!

3.4b Understand . . . how studies of animals with brain lesions can inform us about the workings of the brain.

Researchers have learned a great deal from studies of neurological patients; however, because most accidental brain damage is spread out

across many structures, it is difficult to determine the effect of damage to *a particular structure*. Lesion studies with animals allow researchers to address this type of question by intentionally damaging a very specific region of the brain. These studies also allow researchers to test far more subjects than they could if they were testing humans with brain damage; therefore, animal lesion studies allow researchers to answer more questions than would otherwise be possible.

3.4c Apply . . . your knowledge of neuroimaging techniques to see which ones would be most useful in answering a specific research question.

Complete the first Apply Activity to review the different techniques used to study the brain. Then, complete the second Apply Activity to test your knowledge of the major types of functional neuroimaging.

Apply Activity Windows to the Brain

Review the list of techniques used to study the brain and their descriptions, then select Check Your Understanding when you're ready to see how well you can remember them.

	Description of technique
electroencephalogram	Involves the use of multiple electrodes attached to the scalp. These record the strength, pattern, and location of the brain's electrical activity.
positron emission tomography (PET)	Begins with the injection of radioactive glucose, which can be traced as it fuels neuronal activity. The busiest cells use the most glucose and therefore emit the strongest radioactive signals.
magnetic resonance imaging (MRI)	Applies electromagnetic energy to align hydrogen atoms in the brain. Then, another burst of energy disrupts the orientation of those atoms. The shift in the ions' positions and activity can be detected and used to map the structure of a brain.
functional magnetic resonance imaging (fMRI)	Applies electromagnetic energy to trace the flow of oxygen-rich blood in the brain. The busiest brain cells use the most oxygen, and therefore emit the strongest signals.
magnetoencephalography (MEG)	Measures the magnetic fields that radiate around neurons.

Check Your Understanding

Apply Activity

Review Table 3.6, which summarizes each of the major types of functional neuroimaging. Then decide which one should be used to answer each of the following research questions.

Research Question	Medical Scan Type
Lynn was an epilepsy patient seeking treatment. Her seizures did not involve the muscle twitches typical of grand mal seizures. Instead, she would stop talking and stare blankly into the distance for 20 to 30 seconds (this is known as a petit mal seizure). Her neurologist wanted to use a neuroimaging method to detect when she was having a seizure. Which one should she use?	EEG
Neil was interested in how dopamine neurons in the brain responded when participants were given rewarding foods like jelly beans versus bland foods. Which functional neuroimaging method should he use to answer his question?	PET
Jen wanted to measure the precise brain areas that were active when people experienced pain. Which neuroimaging method would give her this information?	fMRI
Jason was interested in how people pay attention to more than one	

Check Your Understanding

3.4d Analyze . . . whether neuroimaging can be used to diagnose brain injuries.

Several methods for measuring brain activity were covered in this module. A CT scan can provide an initial picture of the brain; this is used most often when a patient first enters the hospital. If a more detailed image is necessary and the patient does not have metal fragments in his body, then MRI is used. If researchers are particularly interested in diagnosing white-matter damage, diffusion tensor imaging (DTI) may be used as well. Additionally, any of the functional imaging methods discussed in this module could show different patterns of activity for individuals with and without brain damage, depending upon the task being performed and the location of the injury.

□
□ □

Chapter 4
Sensation and Perception

Listen to the Audio

4.1 Sensation and Perception at a Glance

- Sensing the World around Us
- Perceiving the World around Us
- Working the Scientific Literacy Model: Backward Messages in Music
- Module 4.1 Summary

4.2 The Visual System

- The Human Eye
- Visual Perception and the Brain
- Working the Scientific Literacy Model: Are Faces Special?
- Module 4.2 Summary

4.3 The Auditory and Vestibular Systems

- Sound and the Structures of the Ear
- The Perception of Sound
- Working the Scientific Literacy Model: The Perception of Musical Beats
- The Vestibular System

Module 4.3 Summary

4.4 Touch and the Chemical Senses

The Sense of Touch

Working the Scientific Literacy Model: Empathy and Pain

The Chemical Senses: Taste and Smell

Multimodal Integration

Module 4.4 Summary

Module 4.1 Sensation and Perception at a Glance

Listen to the Audio

Martin Philbey/Redferns/Getty Images

Learning Objectives

4.1a Know . . . the key terminology of sensation and perception.

4.1b Understand . . . what stimulus thresholds are.

4.1c Understand . . . the principles of Gestalt psychology.

4.1d Apply . . . your knowledge of signal detection theory to identify hits, misses, and correct responses in examples.

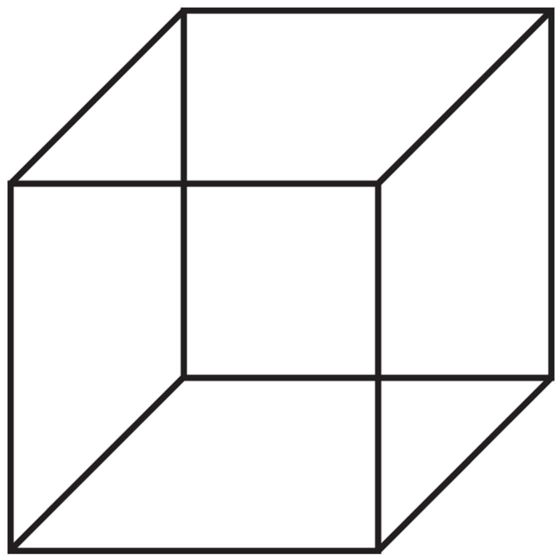
4.1e Analyze . . . claims that subliminal advertising and backward messages can influence your behaviour.

In December 1985, 18-year-old Ray Belknap shot himself to death in Reno, Nevada. His friend James Vance attempted to do the same but survived, his face forever scarred by the shotgun blast. Vance later claimed that his actions were influenced by "subliminal messages" found in the heavy metal music of the band Judas Priest. His family sued the band for damages. The prosecution claimed that when played backwards, the song "Better by You, Better Than Me" contained the phrase "do it." This phrase was allegedly perceived by the two youths, prompting them to attempt suicide. Although this claim seems outlandish, it led to lengthy legal proceedings and received heavy media coverage. It took the work of two Canadian psychologists to demonstrate that these allegations were unfounded. Their research, described later in this module, demonstrates the importance of scientific literacy and provides interesting insights about the abilities—and limitations—of our perceptual systems.

Sensation and perception are different, yet integrated processes. To illustrate this point, take a look at the Necker cube in Figure 4.1. After staring at it for several seconds, the cube may appear to flip its orientation on the page (the side that looks like an interior wall at the back of the cube can also look like the exterior side of the front of the cube).

Although the cube remains constant on the page and in the way it is reflected in the eye, it can be perceived in different ways. The switching of perspectives is a perceptual phenomenon that takes place in the brain.

Figure 4.1 The Necker Cube



Stare at this object for several seconds until it changes perspective.

Source: Based on Galanter, E. (1962). Contemporary psychophysics. In R. Brown, E. Galanter, E. H. Hess, & G. Mandler (Eds.), *New Directions in Psychology* (p. 231). New York: Holt, Rinehart, & Winston.

Sensing the World around Us

Listen to the Audio

The world outside of the human body is full of light, sound vibrations, and objects we can touch. A walk through campus can be filled with the moving shadows of towering trees, the sounds of birds chirping, and the cool crisp air of an autumn morning. In order to make sense of all this information, the body has developed an amazing array of specialized processes for sensing and perceiving the world around us. The process of detecting and then translating the complexity of the world into meaningful experiences occurs in two stages.

The first step is **sensation**, *the process of detecting external events with sense organs and turning those stimuli into neural signals*. At the sensory level, the sound of someone's voice is simply air particles pushing against the eardrum, and the sight of a person is merely light waves stimulating receptors in the eye. All of this raw sensory information is then relayed to the brain, where perception occurs. **Perception** *involves attending to, organizing, and interpreting stimuli that we sense*. Perception includes organizing the different vibrations of the eardrum in a way that allows you to recognize them as a human voice and linking together the stimulation of groups of receptors in the eye into the visual experience of seeing someone walking toward you.

The raw sensations detected by the sensory organs are turned into information that the brain can process through **transduction**, *when specialized receptors transform the physical energy of the outside world into*

neural impulses. These neural impulses travel into the brain and influence the activity of different brain structures, which ultimately gives rise to our *internal representation* of the world.

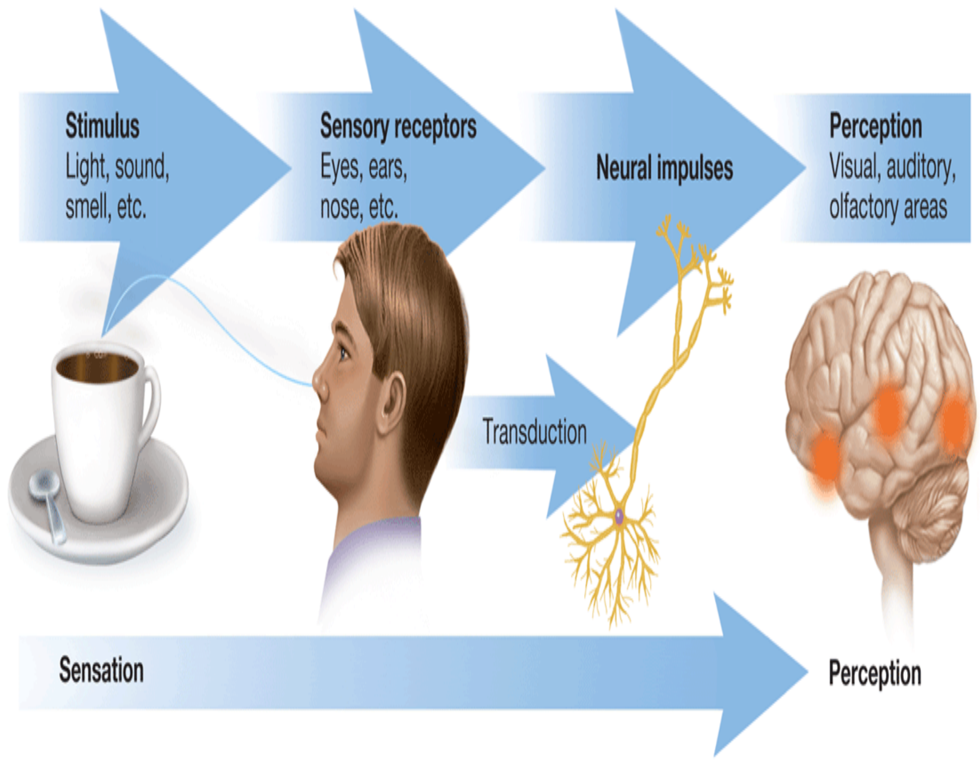
The sensory receptors involved in transduction differ for each sense (summarized in Table 4.1). The transduction of light occurs when it reaches receptors at the back of the eye; light-sensitive chemicals in the retina then convert this energy into nerve impulses that travel to numerous brain centres where colour and motion are perceived and objects are identified (see Figure 4.2). The transduction of sound takes place in a specialized structure in the ear called the cochlea, where sound energy is converted into neural impulses that travel to the hearing centres of the brain.

Table 4.1 Stimuli Affecting Our Major Senses and Corresponding Receptors

Table 4.1 Stimuli Affecting Our Major Senses and Corresponding Receptors

Sense	Stimuli	Type of Receptor
Vision (Module 4.2)	Light waves	Light-sensitive structures at the back of the eye
Hearing (Module 4.3)	Sound waves	Hair cells that respond to pressure changes in the ear
Touch (Module 4.4)	Pressure, stretching, warming, cooling, or piercing of the skin surface	Different types of nerve endings that respond to pressure, temperature changes, and pain
Taste (Module 4.4)	Chemicals on the tongue and in the mouth	Cells lining the taste buds of the tongue
Smell (Module 4.4)	Chemicals contacting mucus-lined membranes of the nose	Nerve endings that respond selectively to different compounds

Figure 4.2 From Stimulus to Perception



Sensing and perceiving begin with the detection of a stimulus by one of our senses. Receptors convert the stimulus into a neural impulse, a process called transduction. Our perception of the stimulus takes place in higher, specialized regions of the brain.

The brain's ability to organize our sensations into coherent perceptions is remarkable. All of our senses use the same mechanism for transmitting information in the brain: the action potential (see Module 3.2). As a result, the brain is continually bombarded by waves of neural impulses representing the world in all its complexity; yet, somehow, it must be able to separate different sensory signals from one another so that we can experience distinct sensations—sight, sound, touch, smell, and taste. It accomplishes this feat by sending signals from different sensory organs to different parts of the brain. Therefore, it is not the original sensory input that is most important for generating our perceptions; rather, it is the brain area that processes this information. We see because visual information gets sent to the occipital lobes, which generate our

experience of vision. We hear because auditory information gets sent to our temporal lobes, which generate our experience of hearing. This idea, that *the different senses are separated in the brain*, was first proposed in 1826 by the German physiologist Johannes Müller and is known as the **doctrine of specific nerve energies**.

Although this separation seems perfectly logical, it requires that distinct pathways connect sensory organs to the appropriate brain structures. Interestingly, these pathways are not fully distinct in the developing brain. Researchers at McMaster University have demonstrated that infants have a number of overlapping sensations (Maurer & Maurer, 1988; Spector & Maurer, 2009). For instance, spoken language elicits activity in areas of the brain related to hearing, but also in brain areas related to vision. This effect does not disappear until age three (Neville, 1995). As children age, the pathways in their brains become more distinct, with less-useful connections being pruned away. Thus, perception is a skill that our brains learn through experience.

Experience also influences how we adapt to sensory stimuli in our everyday lives. Generally speaking, our sensory receptors are most responsive upon initial exposure to a stimulus. For example, when you first walk out of a building onto a sidewalk beside a busy street, the sound from the traffic and the bright sunlight initially seem intense. These sensations occur because our sensory receptors and brain areas related to perception are highly sensitive to change. Changes in our sensory and perceptual worlds elicit an *orienting response*, which allows us to quickly shift our attention to new or altered stimuli.

The flip side of this ability is that we allocate progressively less attention to stimuli that remain the same over time; these unchanging stimuli elicit less activity in the nervous system and are perceived as being less intense over time. So, the sound of traffic or the light outside will seem less

intense after a few minutes than it did when you first exited the building. This process is known as **sensory adaptation**, *the reduction of activity in sensory receptors with repeated exposure to a stimulus*. Sensory adaptation provides the benefit of allowing us to adjust to our surroundings and shift our focus to other events that may be important. However, there are also drawbacks to sensory adaptation. We may get used to listening to loud music in our headphones, which can eventually damage the auditory system. We also stop noticing how polluted and loud city life can be, even though both factors can influence our stress levels and overall health (Evans, 2003).

There is a real-world example of sensory adaptation that most of us experience every day. Watch television for 5 to 10 minutes; but rather than follow the plot of the show, pay attention to how many times the camera angle changes. Directors change the camera angle (and thus your sensation and perception) every few seconds in order to prevent you from experiencing sensory adaptation. The image on the screen will change from wide-angle shots to close-ups of different actors, and that change stimulates your orienting response, making it difficult for you to look away. Whether this over-exposure to rapidly changing stimuli is having a permanent effect on our brains—particularly the developing brains of children—is a hotly debated issue in current psychological research (Bavelier et al., 2010; Ferguson, 2017).

Sensory adaptation is one process that accounts for why we respond less to a repeated stimulus—even to something that initially seems impossible to ignore.

Flashon Studio/Shutterstock

Stimulus Thresholds

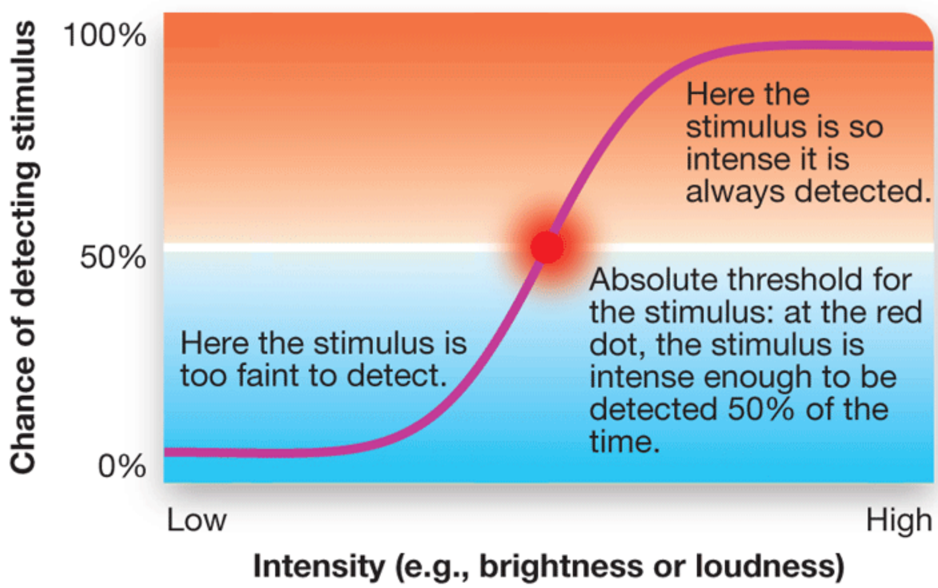
Listen to the Audio

How loud does someone have to whisper for you to hear that person? If you touch a railway track, how sensitive are your fingers to vibrations from a distant train? How does your hearing or sense of touch compare to other people that you know? Are they more or less sensitive? One of the first perception researchers, William Gustav Fechner (1801–1887), was fascinated by such questions. Fechner was a German physicist who was interested in vision. In 1839, he developed an eye disorder that forced him to resign from his academic position. He later recovered, but the experience of having impaired vision—and the effects this had on his thoughts and actions—changed the focus of his research. Fechner helped to create **psychophysics**, *the field of study that explores how physical energy such as light and sound and their intensity relate to psychological experience*. A popular approach was to measure the minimum amount of a stimulus needed for detection, and the degree to which a stimulus must change in strength for the change to be perceptible to people.

An **absolute threshold** is *the minimum amount of energy or quantity of a stimulus required for it to be reliably detected at least 50% of the time it is presented* (Figure 4.3). For example, imagine an experimenter asked you to put on headphones and listen for spoken words; however, they manipulated the volume at which the words were presented so that some could be heard and some could not. Your absolute threshold would be the volume at which you could detect the words 50 % of the time. But your absolute threshold might differ from the person beside you—the

minimum amount of pressure, sound, light, or chemical required for detection varies among individuals and across the lifespan. There are also large differences across species. The family dog may startle, bark, and tear for the door before you can even detect a visitor's approach, and a cat can detect changes in shadows and light that go unnoticed by humans. There is no magic or mystery in either example: These animals simply have lower absolute thresholds for detecting sound and light.

Figure 4.3 Absolute Thresholds



The absolute threshold is the level at which a stimulus can be detected 50% of the time.

Another measure of perception refers to how well an individual can detect whether a stimulus has changed. A **difference threshold** *is the smallest difference between stimuli that can be reliably detected at least 50 % of the time*. When you add salt to your food, for example, you are attempting to cross a difference threshold that your taste receptors can register. Whether you actually detect a difference, known as a *just noticeable difference*, depends primarily on the intensity of the original stimulus. The

more intense the original stimulus, the larger the amount of it that must be added for the difference threshold to be reached. For example, if you add one pinch of salt to a plate of french fries that already had one pinch sprinkled on them, you can probably detect the difference. However, if you add one pinch of salt to fries that already had four pinches applied, you probably will not detect much of a difference. Apparently, to your senses, a pinch of salt does not always equal a pinch of salt.

This effect was formalized into an equation by Ernst Weber (1795–1878), a German physician and one of the founders of psychophysics. **Weber's law** *states that the just noticeable difference between two stimuli changes as a proportion of those stimuli*. Imagine you're holding 50 g of candy in your hand. You may not notice if 1 g of candy is added; instead, let's say that the just noticeable difference is 5 g (i.e., you can tell the difference between 50 g and 55 g of candy). Now let's imagine that your friend hands you 100 g of candy. Again, they start adding candy to your hand to see when you'll notice a change. Weber's law would suggest that the just noticeable difference would be 10 g. If the just noticeable difference of 50 g is 5 g, and if 100 g is 50 g doubled, then the just noticeable difference of 100 g should be 5 g doubled: 10 g.

The study of stimulus thresholds has its limitations. Whether someone perceives a stimulus is determined by self-report—that is, by an individual reporting that they either did or did not detect a stimulus. But not all people are equally willing to say they sensed a weak stimulus. This inconsistency has real-world implications. Think of a radiologist trying to detect tumours in a set of images: If there are differences in the absolute threshold of different radiologists, then one might miss tumours that others would detect. But, this scenario is even more complex—different radiologists might be more or less likely to report seeing a tumour when they are unsure of what they have seen. How do we confirm whether

these stimuli were truly perceived or whether the individuals were just guessing?

Experiment: Weber's Law

INTRODUCTION | INSTRUCTIONS | EXPERIMENT | RESULTS | DISCUSSION | REFERENCE

In studying Sensation and Perception, scientists determine thresholds for detection of stimuli for each of the senses. These studies determine what are known as absolute thresholds and difference thresholds. The absolute threshold is the smallest amount of a stimulus that can be detected by the subject. Thresholds are determined using a variety of procedures, though many involve the random presentation of stimuli of varying levels and tracking each presentation for whether or not the subject indicates they detect the stimulus. The absolute threshold can be determined for a taste, a smell, a light, a sound, or pressure on the skin.

Click or tap Next to continue.

Previous | Next

Signal Detection

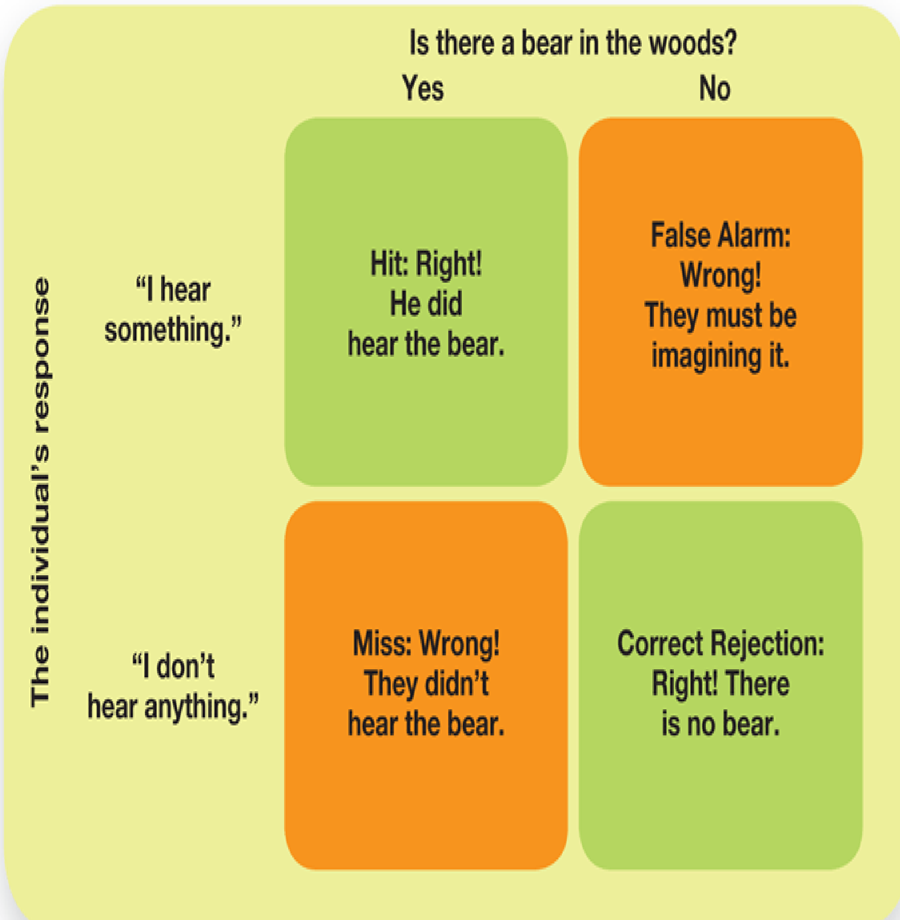
Listen to the Audio

If you are certain that a stimulus exists (e.g., you were hit in the face with a soccer ball), then there is no reason to worry about whether you did or did not perceive something. However, there are many instances in which we must make decisions about sensory input that is uncertain, as in the previous example of a radiologist. It is in these ambiguous situations that signal detection theory can be a powerful tool for the study of our sensory systems. **Signal detection theory** *states that whether a stimulus is perceived depends on both the sensory experience and the judgment made by the subject*. Thus, the theory requires us to examine two processes: a sensory process and a decision process. In a typical signal detection experiment conducted in the laboratory, the experimenter presents either a faint stimulus or no stimulus at all; this is the *sensory process*. The subject is then asked to report whether or not a stimulus was actually presented; this is the *decision process*.

In developing signal detection theory, psychologists realized that there are four possible outcomes (see Figure 4.4). For example, you may be correct that you heard a sound (a *hit*), or correct that you did not hear a sound (known as a *correct rejection*). Of course, you will not always be correct in your judgments. Sometimes you will think you heard something that is not there; psychologists refer to this type of error as a *false alarm*. On other occasions you may fail to detect that a stimulus was presented (a *miss*). By analyzing how often a person's responses fall into

each of these four categories, psychologists can accurately measure the sensitivity of that person's sensory systems.

Figure 4.4 Signal Detection Theory



Signal detection theory recognizes that a stimulus is either present or absent (by relying on the sensory process) and that the individual either reports detecting the stimulus or does not (the decision process). The cells represent the four possible outcomes of this situation. Here we apply signal detection theory to a person alone in the woods.

Studies using signal detection theory have shown that whether a person can accurately detect a weak stimulus appears to depend on a number of

factors (Green & Swets, 1966). First among these is the sensitivity of a person's sensory organs. For instance, some people can detect tiny differences in the tastes of spicy foods, whereas other people experience them all as "hot." In addition to these objective differences, there are also a number of cognitive and emotional factors that influence how sensitive a person is to various sensory stimuli. These include expectations, level of psychological and autonomic-nervous-system arousal, and how motivated a person is to pay attention to nuances in the stimuli. If you were lost in the woods, your arousal level would be quite high. You would likely be better able to notice the sound of someone's voice, the far-off growl of a bear, or the sound of a car on the road than you would be if you were hiking with friends on a familiar trail—even if the surrounding noise level was the same. Why does this difference in sensitivity occur? Is it due to enhanced functioning of your ears (the sensory process) or due to you being more motivated to detect sounds (the decision process)? Research shows that motivational changes are likely to affect the decision process so that you assume that every snapping twig is a bear on the prowl. This change in sensitivity has obvious survival value.

Applying Signal Detection Theory

Imagine a radiologist is examining an image to determine whether a patient has a tumour (positive result), or does not have a tumour (negative result). There are four possible outcomes associated with this task: a hit, a miss, a false alarm, or a correct rejection. Apply signal detection theory to the possible outcomes of the radiologist's decision.

Outcome	Radiologist's Conclusion
hit	There really is a tumour; the radiologist concludes that the test is positive for a tumour.
miss	There really is a tumour; the radiologist concludes that the test is negative for a tumour.
false alarm	There is no tumour; the radiologist concludes the the test is positive for a tumour.
correct rejection	There is no tumour; the radiologist concludes that the test is negative for a tumour.

Check Your Understanding

So far, we have described research about stimuli that individuals consciously perceive. What about information that stimulates the sensory organs but is too weak to reach conscious awareness? Could such weak stimuli still influence our behaviour, thoughts, and feelings? How could we accurately assess such a phenomenon? These questions abound when discussing the myths—and the realities—of subliminal perception.

Myths in Mind

Setting the Record Straight on Subliminal Messaging

Do you think that messages presented to you so rapidly that you couldn’t consciously see them would still influence your behaviour? In the 1950s, a marketing researcher named James Vicary suggested such persuasion can indeed occur. Vicary claimed that by presenting the messages “Eat popcorn” and “Drink Coca-Cola” on a movie screen, he was able to increase

the sales of popcorn and Coke at the theatre. Although later exposed as a hoax, Vicary's claims received a great deal of attention from both the public and the CIA and spawned a huge subliminal self-help industry. But does **subliminal perception** —meaning perception below the threshold of conscious awareness—really exist? And if so, can it really control our motivations, beliefs, and behaviours?

Numerous companies selling subliminal self-help products would like you to believe so. However, research by Canadian psychologists suggests that these claims may be inaccurate. For example, Merikle and Skanes (1992) tested the usefulness of subliminal weight-loss tapes. Female participants were randomly assigned to one of three experimental conditions: (1) subliminal weight-loss tapes, (2) subliminal tapes for the reduction of dental anxiety, and (3) a waiting list (no tapes). The women were weighed before and after a six-week period to see if the tapes affected weight loss. The researchers found no difference among the three groups, suggesting that the tapes were entirely ineffective.

A similar study by American researchers suggests that even if some improvement *were* to occur after participants heard subliminal tapes, these effects may be due to the participants' expectations (Greenwald et al., 1991). In this study, participants were given cassette tapes that supposedly included subliminal messages for improving memory or improving self-esteem. Importantly, the labels on the tapes varied such that half of the participants received the correct cassette–label pairing (e.g., a memory cassette with a memory label) and half received the opposite (e.g., a memory cassette with a self-esteem label). Testing conducted after one month of use showed no effects based on the content of the cassettes. However, there was a

general overall improvement in all conditions, suggesting that simply being in an experiment helped both self-esteem and memory (a result similar to the Hawthorne effect discussed in Module 2.1). Importantly, there was also a trend for participants to believe that the cassettes had produced the desired effect—but this perceived improvement was for the ability that was on the cassette’s label, not necessarily what the participants actually heard. In other words, their expectations led them to believe that they had improved an ability even though they hadn’t received any subliminal help for that ability (i.e., a placebo effect).

The allure of subliminal self-help programs is that individuals can improve themselves without putting forth any effort—the subliminal messages will do the changing for the person. Unfortunately, psychological studies suggest that such effects are due more to the individual’s expectations than to subliminal perception.

Fuse/Corbis/Getty Images

Priming and Subliminal Perception

Listen to the Audio

The fact that subliminal self-help tapes are unlikely to turn you into a multilingual genius with washboard abs does not mean that all subliminal perception is a hoax. We can, in fact, perceive subliminal stimuli *under strict laboratory conditions*. Most laboratory-based studies use a technique known as **priming**, in which previous exposure to a stimulus can influence that individual's later responses, either to the same stimulus or to one that is related to it. Indeed, priming by subliminally presented stimuli has been demonstrated time and again in cognitive psychology experiments (Van den Bussche et al., 2009). In this type of study, experimenters often present a word or an image for a fraction of a second. This presentation is then immediately followed by another image, known as a *mask*, which is displayed for a longer period of time. The mask interferes with the conscious perception of the "subliminal" stimulus—the perceivers are often unaware that any stimulus appeared before the mask (e.g., Cheesman & Merikle, 1986). Yet, a number of brain imaging studies have shown that these rapidly presented stimuli do in fact influence patterns of brain activity (Critchley et al., 2000). Thus, it appears that subliminal perception can occur, and it can produce small effects in the nervous system.

It is important to note that subliminal priming is unlikely to create motivations that hadn't previous existed, a grave concern of many people in the 1950s and 1960s. At best, such messages might enhance a motivation or goal that we already have. Erin Strahan and her colleagues

at the University of Waterloo examined whether subliminally primed words related to thirst would differentially affect thirsty and non-thirsty viewers (Strahan et al., 2002). They found that after viewing thirst-related subliminal stimuli (the words *thirst* and *dry*), thirsty participants drank more of a beverage and rated it more positively than did non-thirsty participants (who were not influenced by the subliminal words). No group difference was found when the subliminally presented words were not thirst-related. These results demonstrate that although subliminally primed words can activate an *already existing* motivational state, they cannot create a *new* motivational state. Furthermore, some work on priming, particularly experiments testing its effects on social behaviour and how we perceive ourselves and others, has not replicated consistently across laboratories (Harris et al., 2013). This remains a hotly debated area of psychology (Cesario, 2014).

Perceiving the World around Us

Listen to the Audio

The study of thresholds, signal detection, and subliminal perception has given us answers to many basic questions about how we sense and perceive our environment. But how do we actually form perceptions from all of this sensory information? The attempt to answer this question has a rich history in psychology, taking us back to the first half of the 20th century.

Gestalt Principles of Perception

Listen to the Audio

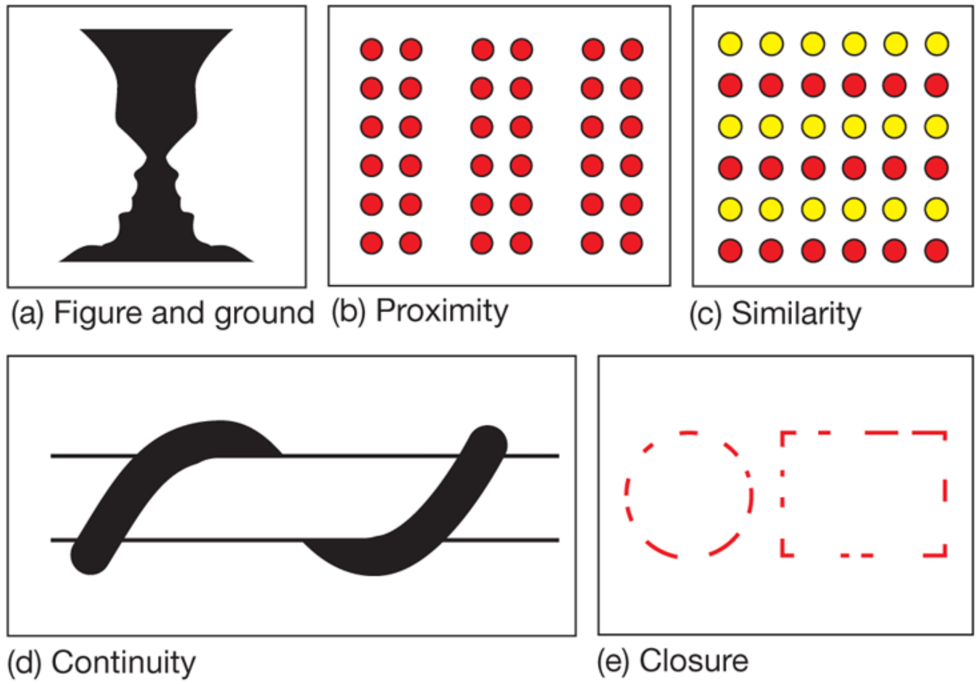
In 1910, Max Wertheimer was riding on a train from Vienna, Austria, to Frankfurt, Germany. As he stared out the window at the Central European countryside, he noticed that the buildings in the distance appeared to be moving backwards. Wertheimer was intrigued by this obvious illusion, and decided to investigate the experience when he arrived in Frankfurt later that day. That evening, he bought himself a stroboscope, a toy that displayed pictures in rapid succession. He noticed that individual pictures did not move; but, when presented within a fraction of a second of each other, the individual images created the perception of movement. This simple observation had an astounding impact on the study of perception, and led to the development of the Gestalt school of psychology.

Gestalt psychology is an approach to perception that emphasizes that "the whole is greater than the sum of its parts." In other words, the individual parts of an image may have little meaning on their own, but when combined, the whole takes on a significant perceived form. Gestalt psychologists identified several key principles to describe how we organize features that we perceive.

One basic Gestalt principle is that objects or "figures" in our environment tend to stand out against a background. Gestalt psychologists refer to this basic perceptual rule as the *figure–ground* principle. The text in front of you is a figure set against a background, but you may also consider the

individual letters you see to be figures against the background of the page. This perceptual tendency is particularly apparent when the distinction between figure and ground is ambiguous, as can be seen in the face–vase illusion in Figure 4.5(a). Do you see a vase or two faces in profile? At the level of sensation, there is neither a vase nor two faces—there is just a pattern. What makes it a perceptual illusion is the recognition that there are two objects, but there is some ambiguity as to which is figure and which is ground. The figure–ground principle applies to hearing as well. When you are holding a conversation with one individual in a crowded party, you are attending to the figure (the voice of the individual) against the background noise (the ground). If the person you are speaking with is uninteresting, you may attend to the music instead of what they are saying to you. In this case, the music would become the figure and the droning voice would become the ground. Exactly which object is the figure and which is the ground at any given moment therefore depends on many factors, including what you are motivated to pay attention to.

Figure 4.5 Gestalt Principles of Form Perception



(a) Figure and ground. (b) Proximity helps us group items together so that we see three columns instead of six rows. (c) Similarity occurs when we perceive the similar dots as forming alternating rows of yellow and red, not as columns of alternating colours. (d) Continuity is the tendency to view items as whole figures even if the image is broken into multiple segments. (e) Closure is the tendency to fill in gaps so as to see a whole object.

Animals and insects take advantage of figure–ground ambiguity to camouflage themselves from predators. Can you see the walking stick insect in this photo?

Brian Lasenby/123RF

Proximity and *similarity* are two additional Gestalt principles that influence perception. We tend to treat two or more objects that are in close proximity to each other as a group. Because of their proximity, people standing next to each other in a photograph are assumed to be a group. Similarity can be experienced by viewing groups of people in uniform, such as two different teams on a soccer field or police facing off against protesters at the 2019 Yellow Vest protests in Paris. We tend to

group together individuals wearing the same uniform based on their visual similarity.

Some other key Gestalt principles are also illustrated in Figure 4.5.
Continuity, or “good continuation,” refers to the perceptual rule that lines and other objects tend to be continuous, rather than abruptly changing direction. The black object snaking its way around the white object is viewed as one continuous object rather than as two separate ones. A related principle, called *closure*, refers to the tendency to fill in gaps to complete a whole object.

It is important to note that Gestalt concepts are not simply a collection of isolated examples. Rather, when put together, they demonstrate an incredibly important characteristic of perception: we create our own organized perceptions out of the different sensory inputs that we experience. The next time you go outside, look at how we create organized perceptions of architecture, interior design, fashion, and even corporate logos. All of these examples show how much of “you” is in your perceptual experience of the world.

The principle of similarity in action. We perceive groups of police (who are dressed similarly) and protesters, rather than hundreds of individuals.

ALEXANDROS MICHAILIDIS/Alamy Stock Photo

The illusions and figures you have viewed in this section reveal some common principles that guide how we perceive the world. We can take this exploration a step further by discussing the cognitive processes that underlie these principles, a topic that brings us back to the controversial court case discussed at the beginning of this module.

Working the Scientific Literacy Model

Backward Messages in Music

Listen to the Audio

Humans are experts at pattern recognition. This ability to detect patterns is the basis for our ability to understand speech. To newborn babies, speech is probably a series of nonsense sounds. With experience, they are able to group together familiar combinations of sounds that occur frequently in the local language. This, in turn, leads to the perception of spoken words. But how sophisticated are these pattern-recognition abilities? This question is central to the issue of backward messages in music.

What do we know about backward messages in music?

The idea that music can contain backward messages has a long history. Fans have reported finding evidence of these messages in a few songs from The Beatles. "Messages" have also been found in 1970s songs by Led Zeppelin and Queen. For example, when Queen's song "Another One Bites the Dust" is played backwards, some listeners claim to hear "It's fun to smoke marijuana." However, most examples of backward messages are due to *phonetic reversal*, where a word pronounced backwards sounds like another word (e.g., *dog* and *god*). Indeed, in most cases, the bands claim to be unaware that any backward messages exist

(although a few bands, such as Pink Floyd, intentionally inserted messages, oftentimes to poke fun at conspiracy theorists).

Importantly, until the 1980s, few people believed that these messages could be *perceived* when the music was played forward (i.e., properly), let alone that these messages could *influence people's behaviour*. This changed with the Judas Priest lawsuit discussed at the beginning of this module. In that case, the prosecution claimed that "backward messages" in the music caused two boys to attempt suicide. Could psychology research explain whether these claims were valid?

How can science explain backward messages?

John Vokey and Don Read (1985) from the University of Lethbridge conducted a series of studies that related to the backward messages controversy. These researchers recorded a number of passages onto audio cassettes and then played the cassettes backwards for participants. They found that people could make superficial judgments about the gender of the speaker (98.9% correct), about whether two speakers were the same (78.5% correct), and about the language being spoken—English, French, or German (46.7% correct, where chance performance is 33.3%). However, when asked to make judgments about the *content* of the backward messages, performance fell to chance levels. Participants were unable to distinguish between nursery rhymes, Christian, satanic, pornographic, or advertising messages (19.1% correct, where chance performance is 20%).

But, what if the participants knew what patterns to listen for? It is a common experience that when a backward message is identified in a song and people are told the message in advance, they are able to identify it. To test whether such expectations could influence perception, Vokey and Read asked participants to

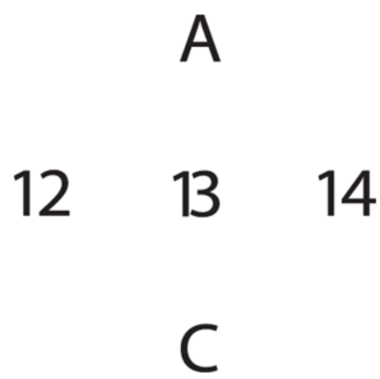
listen for specific phrases in the backward messages (these were "phrases" that the researchers had picked out after repeatedly listening to the backward stimuli). When asked to listen for "Saw a girl with a weasel in her mouth" and "I saw Satan," 84.6% of the participants agreed that the phrases were perceivable.

Can we critically evaluate this research?

One concern with Vokey and Read's experiments was that the participants may have been experiencing demand characteristics, producing responses that they thought the experimenter wanted to hear. Such an explanation could easily be tested using more modern technology than was available in the mid-1980s. If participants listened to audio files using headphones and were prompted by a question on a computer rather than by an experimenter, it would help rule out this alternative explanation of the results.

This minor criticism aside, the results do provide a nice demonstration of the fact that our perceptions of the world are influenced both by the stimuli themselves as well as by our own mindset. For example, the centre of Figure 4.6 can be perceived as either the number 13 or the letter B depending upon whether you're reading numbers (12 and 14) or letters (A and C). This is an example of **top-down processing**, *when our perceptions are influenced by our expectations or by our prior knowledge*. Reading "12" and "14" gives us the expectation that the ambiguous stimulus in between them must be "13." In the backward messages experiment, participants used top-down processing to perceive specific phrases.

Figure 4.6 Top-Down Processing



Is the centre the letter B or the number 13?

Source: Copyright Bruner, J. S., & Minturn, A., L. (1955). Perceptual identification and perceptual organization. *The Journal of General Psychology, 53(1)*, 21–28. Reproduced by permission of Taylor & Francis LLC (www.tandfonline.com).

If the participants were not given any directions from the experimenters and instead simply listened to the music played backward and tried to detect messages based on the different sounds that could be heard, they would be engaging in a different type of processing. **Bottom-up processing** *occurs when we perceive individual bits of sensory information (e.g., sounds) and use them to construct a more complex perception (e.g., a message)*. As you might expect, bottom-up processing would occur when you encounter something that is unfamiliar or difficult to recognize.

Top-down and bottom-up processing can be studied using some interesting stimuli, such as the image in Figure 4.7. When you initially looked at this image, you may have seen either a rat or a man. Unless you were surrounded by animals or a lot of people, there was very little to guide your perception of the image—you used bottom-up processing and were just as likely to have thought the image was a rat or a man. However, when people first look at pictures of animals and then look at this ambiguous image, they tend to see the rat first; if they first look at pictures of people, they tend to see the man first. Thus, top-down processes can influence the perception of the image as well. In short, the

way we perceive the world is a combination of both top-down and bottom-up processing (Beck & Kastner, 2009).

Figure 4.7 Expectations Influence Perception

Is this a rat or a man's face? People who look at pictures of animals before seeing this image see a rat, whereas those looking at pictures of faces see the image as a man's face.

Incidentally, Vokey and Read were asked to testify in the Judas Priest case in order to explain how their psychology experiments related to the legal proceedings. Judas Priest was found not guilty.

Why is this relevant?

These results suggest that we interpret patterns of stimuli in ways that are consistent with our expectations. Several researchers have demonstrated that it is possible to form a *perceptual set*—a filter that influences what aspects of a scene we perceive or pay attention to. But, focusing on particular patterns of stimuli also means that we are *not* focusing on other patterns; in some cases,

we ignore pieces of information that don't fit with our expectations. In the backward messages study, participants had to ignore many different sounds in order to detect the sounds that resembled "Saw a girl with a weasel in her mouth." As we'll see in the next section, sometimes our perceptual sets are so fixed that we fail to notice unexpected objects that are clearly visible . . . and very interesting.

Attention and Perception

Listen to the Audio

The example of backward messages shows us that what we pay attention to can affect what we perceive. In fact, in many cases, we are *paying attention to more than one stimulus or task at the same time*, a phenomenon known as **divided attention**. Simultaneously playing a video game and holding a conversation involves divided attention; so does using Instagram and Twitter while you are listening to your psychology professor lecture, or attempting to text and drive. Although we often feel that dividing our attention is not affecting our performance, there is substantial evidence from both laboratory and real-world studies telling us otherwise (Pashler, 1998; Stevenson et al., 2013).

In contrast, **selective attention** *involves focusing on one particular event or task*, such as focused studying, driving without distraction, or attentively listening to music or watching a movie. In this case, you are paying more attention to one part of your environment so that you can accurately sense and perceive the information it might provide (e.g., watching the road while driving). While useful, this process comes at a cost—your perception of other parts of your environment suffers (e.g., you don't notice the birds in the trees, or you walk into a fountain in the mall because you're focused on texting). Most of the time, selective attention is quite beneficial; however, there are times when this focus is so powerful that we fail to perceive some very obvious things.

Imagine you are watching your favourite team play basketball. You're a big fan of a particular player and are intently watching their every move. Would you notice if a person in a gorilla suit ran onto the court for a few seconds? Most people would say "yes." However, psychological research suggests otherwise. Missing the obvious can be surprisingly easy—especially if you are focused on just one particular aspect of your environment. For example, researchers asked undergraduate students to watch a video of students dressed in white t-shirts actively moving around while passing a ball to one another. The participants' task was to count the number of times the ball was passed. To complicate matters, there were also students in black t-shirts doing the same thing with another ball; however, the participants were instructed to ignore them. This is a top-down task because the participants selectively attended to a single set of events. The participants in this study found the task very easy; most were able to accurately count the number of passes, give or take a few.

But what if a student wearing a gorilla suit walked through the video, stopped, pounded her chest, and walked off screen? Who could miss that? Surprisingly, about half the participants failed to even notice the gorilla (Simons & Chabris, 1999). This number was even higher in elderly populations (Graham & Burke, 2011). This result is an example of **inattentional blindness**, *a failure to notice clearly visible events or objects because attention is directed elsewhere* (Mack & Rock, 1998). You can imagine how shocked the participants were when they watched the film again without selectively attending to one thing and realized they had completely missed the gorilla. Inattentional blindness shows that when we focus on a limited number of features, we might not pay much attention to anything else.

Inattentional blindness accounts for many common phenomena. For example, people who witness automobile accidents or criminal behaviour

may offer faulty or incomplete testimony. In sports, athletes and referees often miss aspects of a game because they are focusing on one area of action (Memmert & Furley, 2007); inattentional blindness decreases as expertise with the game increases (Furley et al., 2010). Interestingly, research conducted at Dalhousie University has shown that stimuli that were not perceived in an inattentional blindness study still influenced performance on later memory tasks, suggesting that these stimuli can in fact influence our perceptual system (Butler & Klein, 2009). Although this doesn't necessarily mean that referees will be haunted by missed calls, it does mean that the refs weren't blind—just inattentionally blind.

Do you think you would fail to notice the student in the gorilla suit at a basketball game (top photo, Simons & Chabris, 1999)?

Source: Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception, 28*, 1059–1074. Figure provided by Daniel Simons.

Reading about inattentional blindness might lead you to question whether our attentional and perceptual systems work well at all. However, as you will see in the modules in this text our systems for sensing and perceiving are highly complex and adaptive, imperfect as they may be at times.

Psychologist Anthony Barnhart conducts experiments on attention using simple magic tricks as stimuli. In this study, participants watched a video of him placing two napkins on the table, the one on his right covering a coin (as shown in the first two photos). After covering each napkin with a coffee cup, he reveals that the coin is no longer under the napkin on the right—it has moved to the left. As the trick unfolds, Barnhart records participant's eye movements to measure what they spend the most time watching. The compiled results are shown in the third photo, with the red area indicating the greatest level of attention. This image shows the crucial moment where he slides the coin from one side to another; most participants did not notice because they were focused on the cup—an instance of inattentional blindness.

Source: Barnhart & Goldinger, 2014

Module 4.1 Summary

Listen to the Audio

4.1a Know . . . the key terminology of sensation and perception.

Review Module 4.1

Start Over | Swap

0/17 REVIEWED · 0 MASTERED

selective attention

Previous | Next | Got It!

4.1b Understand . . . what stimulus thresholds are.

Stimulus thresholds can be either *absolute* (the minimum amount of energy to notice a stimulus) or based on *difference* (the minimum change between stimuli required to notice they are different).

4.1c Understand . . . the principles of Gestalt psychology.

A key principle of Gestalt psychology is that although the individual parts of a stimulus may have little meaning on their own, these parts can be grouped together in ways that are perceived as distinct patterns or objects. For instance, individual stimuli can be grouped together according to principles of figure and ground, proximity, similarity, continuity, and closure.

4.1d Apply . . . your knowledge of signal detection theory to identify hits, misses, and correct responses in examples.

Apply Activity

For practice, consider Figure 4.4, along with this example: Imagine a student is taking a new route to class in order to avoid running into an acquaintance who insists on sharing every detail of their previous evening. The student bristles at the thought of hearing the familiar call of their name as they scurry across the quad. Identify which of the four events (A–D) goes within the correct box; that is, identify it as a hit, a miss, a false alarm, or a correct rejection. Answers can be found in the Answer Key.

Hit:	False alarm:
Miss:	Correct rejection:

A. The acquaintance is not nearby and the student is confident they did not hear anything.

B. The acquaintance shouted the student's name, but they did not hear it.

C. The acquaintance shouted the student's name, and they heard it.

D. The acquaintance is not there, but the student insists they heard their name being called.

4.1e Analyze . . . claims that subliminal advertising and backward messages can influence your behaviour.

As you read in the Priming and Subliminal Perception section of this module, we *can* sometimes perceive stimuli below the level of conscious awareness, and this perception can affect our behaviour in some ways. However, as noted in the Myths in Mind feature, research suggests that subliminal advertising has little effect on our consumer behaviour. Similarly, studies of backward messages in music have shown that individuals typically do not perceive the meaning of these messages *unless they are specifically told what they should listen for*, suggesting that the devil in heavy metal music is really just top-down processing.

Module 4.2 The Visual System

Listen to the Audio

James Gourley/Shutterstock

Learning Objectives

4.2a Know . . . the key terminology relating to the eye and vision.

4.2b Understand . . . how visual information travels from the eye through the brain to give us the experience of sight.

4.2c Understand . . . the theories of colour vision.

4.2d Apply . . . your knowledge to explain how we perceive depth in our visual field.

4.2e Analyze . . . how we perceive objects and faces.

On Canada Day in 2015, Canadian tennis star Milos Raonic hit a serve that was clocked at 233 km/h (145 mph) against his opponent, German Tommy Haas. At the time, it was the third fastest serve in the 138-year history of the Wimbledon championship. Remarkably, Haas managed to return the serve, although he ended up losing the point to the powerful Canadian. Although spectators were impressed by the skill and athleticism of both athletes on that sunny July afternoon, they were also witness to something equally stunning: the power and complexity of the human visual system.

In order for Haas to return Raonic's serve, he had to identify a yellowish-green tennis ball against a dark green background, follow the ball as it landed on a light-green grass-court surface, and track its trajectory as it bounced toward him. Doing so required him to be able to perceive different colours, perceive and identify particular objects in his visual field, and perceive motion. Haas's visual system also had to work with his motoric (movement) system so that he could move his racquet (and thus his hand and arm) in order to return the serve. That all of this took place in a fraction of a second is especially remarkable.

Although both Raonic and Haas are professional athletes, their exceptional visual abilities did not develop overnight; they are the product of years of training. Vision—and the movements and cognition that go with it—is something we fine-tune with experience.

The world is a visual place to most humans. We use vision to navigate through beautiful landscapes, city centres, and the interiors of buildings. We also use vision to communicate via facial expressions and the written word (such as this text, which you undoubtedly photocopy and tape to your bedroom walls). In this module, we explore how vision works—starting out as patterns of light entering the eye, and ending up as a complex, perceptual experience. We begin with an overview of the basic physical structures of the eye and brain that make vision possible, and then discuss the *experience* of seeing.

The Human Eye

Listen to the Audio

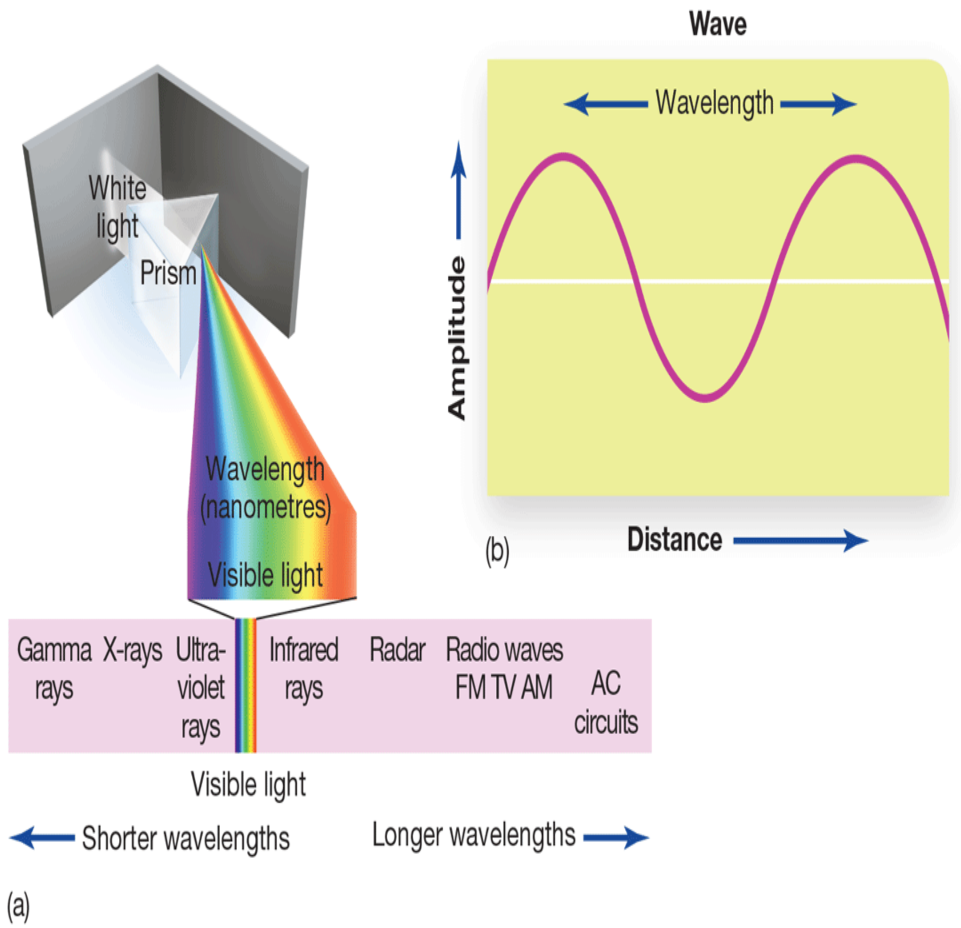
The eye is one of the most remarkable of the human body's physical structures. It senses an amazing array of information, translates that information into neural impulses, and transfers it to the brain for complex perceptual processing. To ensure that this sequence of events begins correctly, the eye needs specialized structures that allow us to regulate how much light comes in, to respond to different wavelengths of light, to maintain a focus on the most important objects in a scene, and to turn physical energy into action potentials, the method by which information is transmitted in the brain.

How the Eye Gathers Light

Listen to the Audio

The primary function of the eye is to gather light and change it into an action potential. But "light" itself is quite complex. Although physicists have written vast tomes on the topic of light, for the purposes of human perception, "light" actually refers to radiation that occupies a relatively narrow band of the electromagnetic spectrum, shown in Figure 4.8a. Light travels in waves that vary in terms of two different properties: length and amplitude. The term *wavelength* refers to the distance between peaks of a wave—differences in wavelength correspond to different colours on the electromagnetic spectrum. As you can see from Figure 4.8a, long wavelengths correspond to our perception of reddish colours and short wavelengths correspond to our perception of bluish colours. The different shades of green found in the tennis match described in the opening of this module would represent wavelengths of light in between the wavelengths of red and blue. Interestingly, some organisms, such as bees, can see ultraviolet light and some reptiles can see infrared light. These interspecies differences are likely due to the different evolutionary demands these species have faced. What pressures do you think led humans to develop their specific visual system? Although no one can answer this question with absolute certainty, some researchers have suggested that our red–green vision allowed us to distinguish between types of edible vegetation (Regan et al., 2001).

Figure 4.8 Light Waves in the Electromagnetic Spectrum



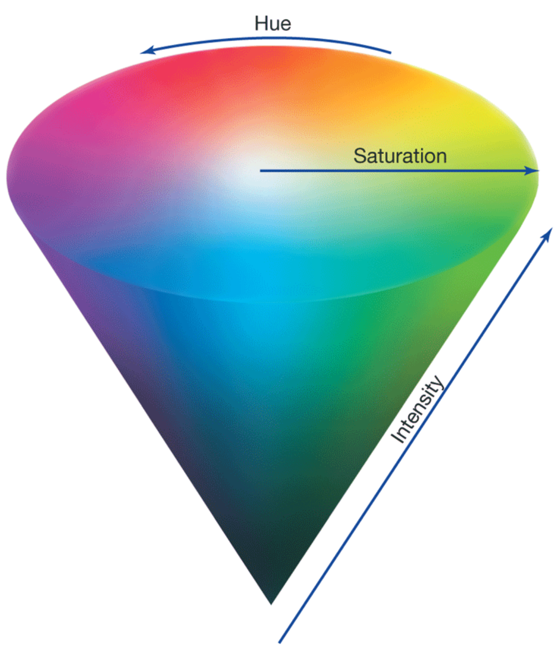
(a) The electromagnetic spectrum: When white light travels through a prism, the bending of the light reveals the visible light spectrum. The visible spectrum falls within a continuum of other waves of the electromagnetic spectrum. (b) Wavelength is measured by distance between the peaks (or the troughs) of the waves.

Source: Ciccarelli, Saundra K.; White, J. Noland, *Psychology: An Exploration*, 1st Ed., ©2010, p. 79. Reprinted and Electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Wavelength is not the only characteristic that is important for vision. *Amplitude* refers to the height of a wave (see Figure 4.8b). Low-amplitude waves are seen as dim colours, whereas high-amplitude waves are seen as bright colours. Light waves can also differ in terms of how many different wavelengths are being viewed at once. When you look at a clear blue sky, you are viewing many different wavelengths of light at the same time—but the blue wavelengths are more prevalent and

therefore dominate your impression; when our visual angle to the sun changes at dusk, different light frequencies are more apparent, giving the sky a reddish colour. If a large proportion of the light waves are clustered around one wavelength, you will see an intense, vivid colour. If there are a large variety of wavelengths being viewed at the same time, the colour will appear to be "washed out." Figure 4.9 depicts these characteristics of light—wavelength, amplitude, and purity—as we generally perceive them. These characteristics of light will be experienced by us as *hue* (colour of the spectrum), *intensity* (brightness), and *saturation* (colourfulness). Saturation can also be thought of as the purity of a colour; think of a freshly made red brick next to one that has faded from prolonged exposure to the elements. It is in the eye that this transformation from sensation to perception takes place.

Figure 4.9 Hue, Intensity, and Saturation



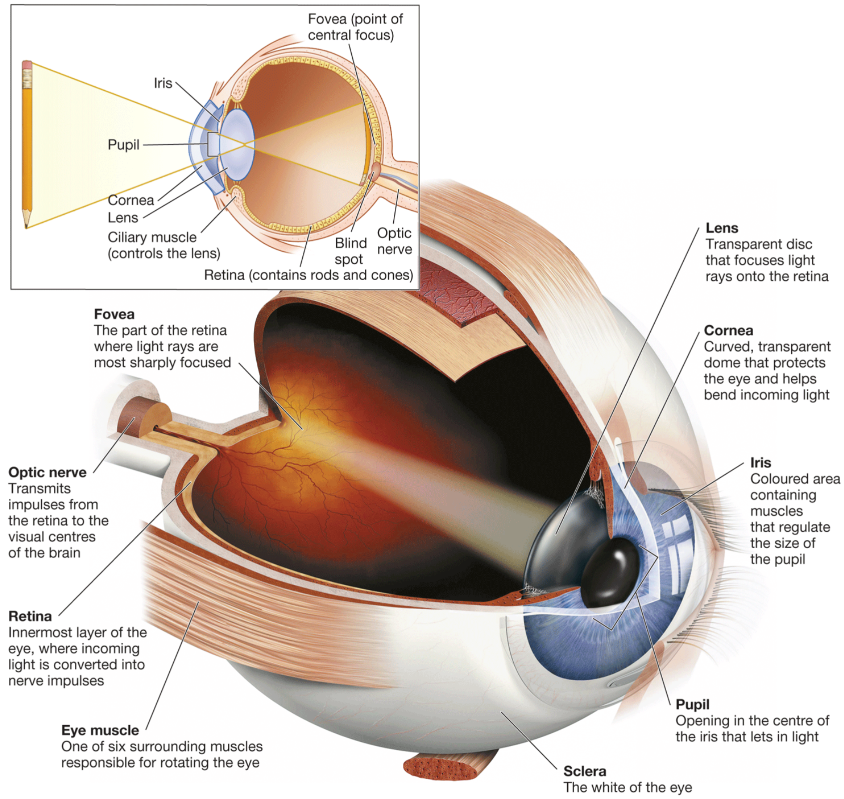
Colours vary by hue (colour), intensity (brightness), and saturation (colourfulness or "purity").

The Structure of the Eye

Listen to the Audio

The eye consists of specialized structures that regulate the amount of light that enters the eye and organizes it into a pattern that the brain can interpret (see Figure 4.10). The **sclera** *is the white, outer surface of the eye* and the **cornea** *is the clear layer that covers the front portion of the eye and also contributes to the eye's ability to focus*. Light enters the eye through the cornea and passes through an opening called the pupil. The **pupil** *regulates the amount of light that enters by changing its size; it dilates (expands) to allow more light to enter and constricts (shrinks) to allow less light into the eye*. The changes in the pupil's size are performed by the **iris**, *a round muscle that adjusts the size of the pupil; it also gives the eyes their characteristic colour*. Behind the pupil is the **lens**, *a clear structure that focuses light onto the back of the eye*. The lens can change its shape to ensure that the light entering the eye is refracted in such a way that it is focused when it reaches the back of the eye. This process is known as *accommodation*. When the light reaches the back of the eye, it will stimulate a layer of specialized receptors that convert light into a message that the brain can then interpret, a process known as *transduction* (see Module 4.1). These receptors are part of a complex structure known as the retina.

Figure 4.10 The Human Eye and Its Structures

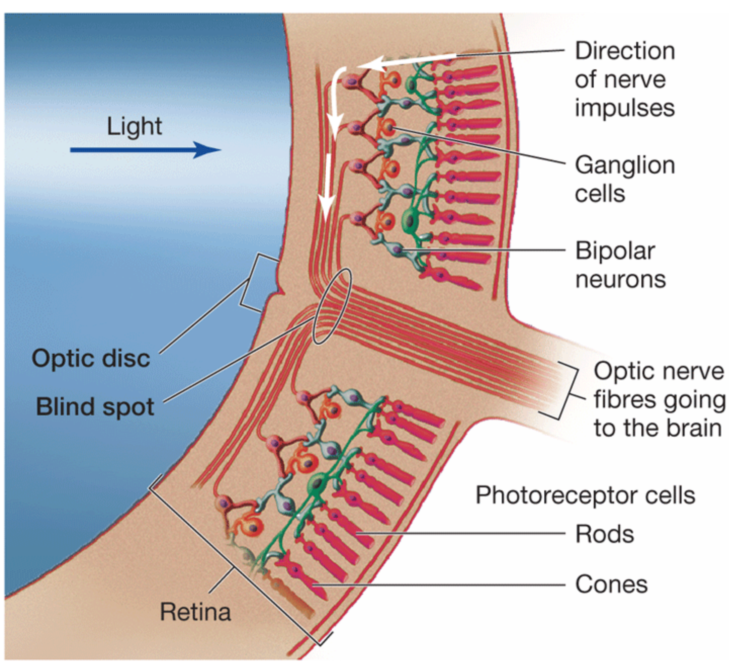


Notice how the lens inverts the image that appears on the retina (see inset). The visual centres of the brain correct the inversion.

Watch The Structure of the Eye

The **retina** *lines the inner surface of the back of the eye and consists of specialized receptors that absorb light and send signals related to the properties of light to the brain*. The retina contains a number of layers, each performing a slightly different function. At the back of the retina are specialized receptors called *photoreceptors*. These receptors, which will be discussed in more depth shortly, are where light will be transformed into a neural signal that the brain can understand. It may seem strange that light would stimulate the deepest layer of the retina, with the neural signal then turning around and moving forward in the eye (see Figure 4.11); however, there is a reason for this backward design. Having the photoreceptors wedged into the back of the eye protects them and provides them with a constant blood supply, both of which are useful to your ability to see. There is another reason why the eye appears to have a backward design. Intermixed within the nerve cells in front of the retina are specialized glial cells that help gather and guide light to targeted areas of the retina. These cells help optimize our ability to see colour in daytime conditions (Labin & Ribak, 2010).

Figure 4.11 Arrangement of Photoreceptors in the Retina



Bipolar and ganglion cells collect messages from the light-sensitive photoreceptors and converge on the optic nerve, which then carries the messages to the brain.

Information from the photoreceptors at the back of the retina is transmitted to the ganglion cells closer to the front of the retina. The ganglion cells gather up information from the photoreceptors; this information will then alter the rate at which the ganglion cells fire. The activity of all of the ganglion cells is then sent out of the eye through the **optic nerve**, *a dense bundle of fibres that connect to the brain*. This nerve presents a challenge to the brain. Because it travels through the back of the eye, it creates an area on the retina with no photoreceptors, called the *optic disc*. The result is a *blind spot*—a space in the retina that lacks photoreceptors. You can discover your own blind spot by performing the activity described in Figure 4.12.

Figure 4.12 Finding Your Blind Spot

To find your blind spot, close your left eye and, with your right eye, fix your gaze on the + in the green square. Slowly move closer to the screen. When the screen is approximately 15 cm (6 inches) away, you will notice

that the black dot on the right disappears because of your blind spot. Not only does the black dot disappear, but its vacancy is replaced by yellow: The brain “fills it in” for you.

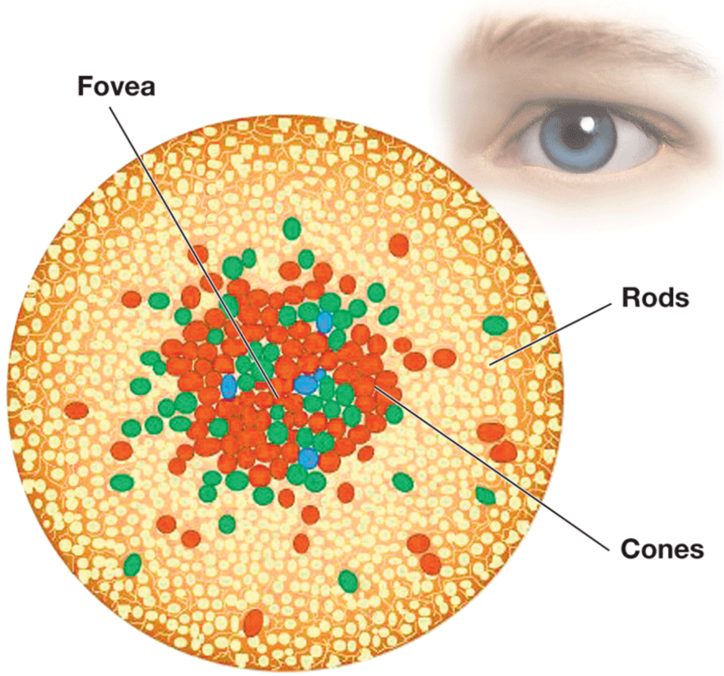
The blind spot illustrates just how distinct the processes of sensation and perception are. Why do we fail to notice a completely blank area of our visual field? If we consider only the process of sensation, we cannot answer this question. We have to invoke perception: The visual areas of the brain are able to “fill in” the missing information for us (Ramachandran & Gregory, 1991). Not only does the brain fill in the missing information, but it does so in context. Thus, once the black dot at the right of Figure 4.12 reaches the blind spot, the brain automatically fills in the vacancy with yellow.

The Retina: From Light to Nerve Impulse

Listen to the Audio

Now that you have read an overview of the eye's structures, we can ask an important question: How can the firing of millions of little photoreceptors in the retina produce vivid visual experiences like seeing white-clad tennis players running around a light-green court surrounded by thousands of spectators wearing clothes in a variety of colours? The simple answer is that not all photoreceptors are the same. There are two general types of photoreceptors—*rods* and *cones*—each of which responds to different characteristics of light. **Rods** *are photoreceptors that occupy peripheral regions of the retina; they are highly sensitive under low light levels* (see Figure 4.13). This type of sensitivity makes rods particularly responsive to black and grey. In contrast, **cones** *are photoreceptors that are sensitive to the different wavelengths of light that we perceive as colour*. Cones tend to be clustered around the **fovea**, *the central region of the retina*.

Figure 4.13 Distribution of Rods and Cones on the Retina



Cones are concentrated at the fovea, the centre of the retina, while rods are more abundant in the periphery. There are approximately 120 million rods and approximately 6 to 8 million cones in the adult retina.

When the rods and cones are stimulated by light, their physical structure briefly changes, which alters the activity of neurons in the different layers of the retina. The final layer to receive this changed input consists of ganglion cells, which will eventually output to the optic nerve. Interestingly, the ratio of ganglion cells to cones in the fovea is approximately one to one; in contrast, there are roughly 10 rods for every ganglion cell. So, all of the input from a cone is clearly transmitted to a ganglion cell, whereas the input from a rod must compete with input from other rods (similar to 10 people talking at you at the same time). So, cones are clustered in the fovea (i.e., at the centre of our visual field) and have a one-to-one ratio with ganglion cells, while rods are limited to the periphery of the retina and have a ten-to-one ratio with ganglion cells. These differences help explain why colourful stimuli are often perceived

as sharp images while shadowy grey images are perceived as being hazy or unclear.

In daylight or under artificial light, the cones in the retina are more active than rods—they help us to detect differences in the colour of objects and to discriminate the objects' fine details. In contrast, if the lights suddenly go out or if you enter a dark room, at first you see next to nothing. Over time, however, you gradually begin to see your surroundings more clearly. **Dark adaptation** *is the process by which the rods and cones become increasingly sensitive to light under low levels of illumination*. What is actually happening during dark adaptation is that the photoreceptors are slowly becoming regenerated after having been exposed to light. Cones regenerate more quickly than do rods, often within about 10 minutes. However, after this time, the rods become more sensitive than the cones. Indeed, we do not see colour at night or in darkness because rods are more active than cones under low light levels.

The phenomenon of dark adaptation explains why we can find our friends in a dark movie theatre. It does not, however, explain why we perceive the sky as being blue or a stop sign as being red. Luckily, 200 years of vision research has provided answers to such questions.

The Retina and the Perception of Colours

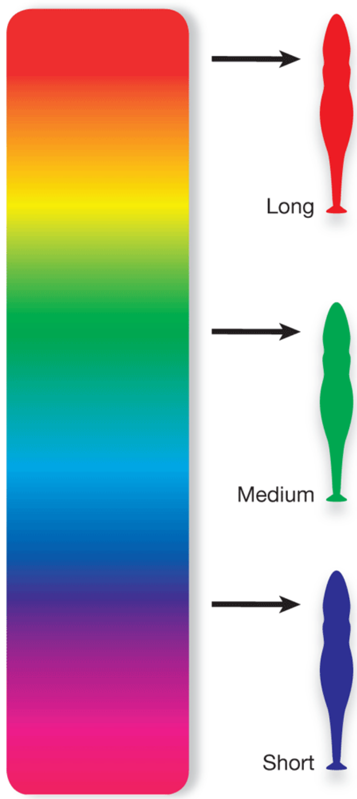
Listen to the Audio

Our experience of colour is based on how our visual system interprets different wavelengths on the electromagnetic spectrum (refer back to Figure 4.8). Colour is not actually a characteristic of the objects themselves, rather it is an interpretation of these wavelengths by the visual system. As you learned earlier, the cones of the retina are specialized for responding to different wavelengths of light that correspond to different colours. However, the subjective experience of colour occurs in the brain. Currently, two theories exist to explain how cells and photoreceptors in the eye can produce these colourful experiences.

One theory suggests that three different types of cones exist, each of which is sensitive to a different range of wavelengths on the electromagnetic spectrum. These three types of cones were initially identified in the 18th century by physicist Thomas Young and then independently rediscovered in the 19th century by Hermann von Helmholtz. The resulting **trichromatic theory** (or **Young-Helmholtz theory**) *maintains that colour vision is determined by three different cone types that are sensitive to short, medium, and long wavelengths of light*. These cones respond to wavelengths associated with the colours blue, green, and red. The relative responses of the three types of cones allow us to perceive the many different colours that comprise the spectrum (see Figure 4.14). For example, yellow is perceived by combining the stimulation of red- and green-sensitive cones, whereas light that

stimulates all cones equally is perceived as white. (Note: mixing different wavelengths of light produces different colours than when you mix different colours of paint.) Modern technology has been used to measure the amount of light that can be absorbed in cones and has confirmed that each type responds to different wavelengths. Thus, *some* aspects of our colour vision can be explained by the characteristics of the cones in our retinas.

Figure 4.14 The Trichromatic Theory of Colour Vision

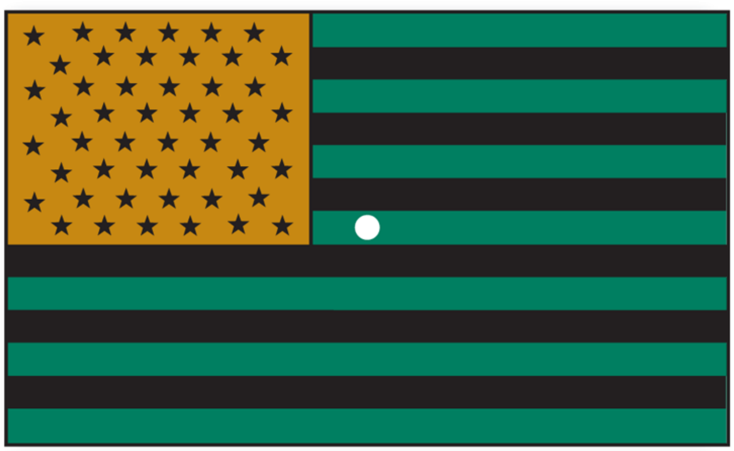


According to this theory, humans have three types of cones that respond maximally to different regions of the colour spectrum. Colour is experienced by the combined activity of cones sensitive to short, medium, and long wavelengths.

However, not all colour-related experiences can be explained by the trichromatic theory. For instance, stare at the image in Figure 4.15 for

about a minute and then look toward a white background. After switching your gaze to a white background, you will see the colours red, white, and blue rather than green, black, and yellow. How can we explain this tendency to see such a *negative afterimage*, a different colour from the one you actually viewed? In the 19th century, Ewald Hering proposed the **opponent-process theory** of colour perception, *which states that we perceive colour in terms of opposing pairs: red to green, yellow to blue, and white to black*. This type of perception is consistent with the activity patterns of retinal ganglion cells. A cell that is stimulated by red is inhibited by green; when red is no longer perceived (as when you suddenly look at a white wall), a "rebound" effect occurs. Suddenly, the previously inhibited cells that fire during the perception of green are free to fire, whereas the previously active cells related to red no longer do so. The same relationship occurs for yellow and blue as well as for white and black.

Figure 4.15 The Negative Afterimage: Experiencing Opponent-Process Theory



Stare directly at the white dot within the flag and avoid looking away. After about a minute, immediately shift your focus to a white background. What do you see? What colours would you use to create a Canadian flag afterimage?

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed. ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

The trichromatic and opponent-process theories are said to be complementary because both are required to explain how we see colour. The trichromatic theory explains colour vision in terms of the activity of cones. The opponent-process theory of colour vision explains what happens when ganglion cells process signals from a number of different cones at the same time. Together, they allow us to see the intense world of colours that we experience every day.

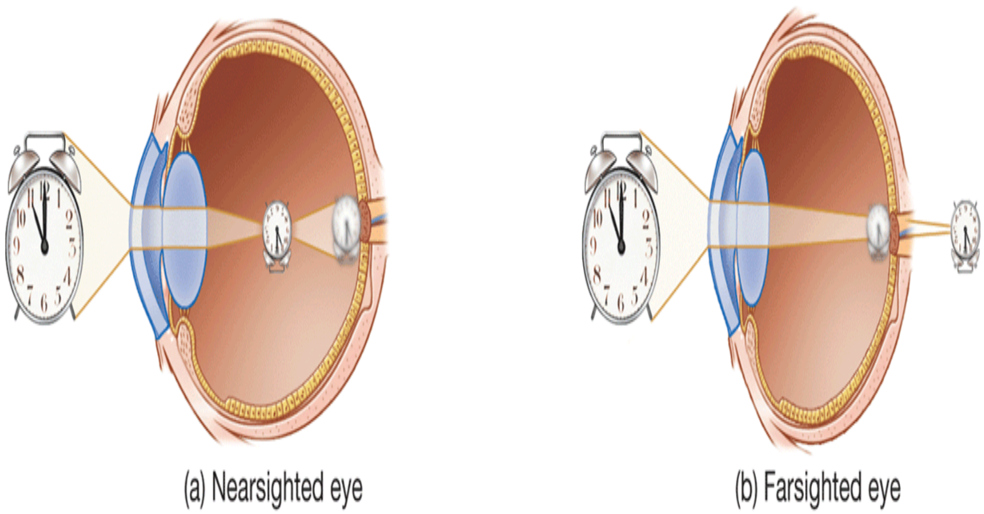
Common Visual Disorders

Listen to the Audio

Of course, not everyone can see colours. In fact, many people reading this book will have some form of *colour blindness*. Most forms of colour blindness affect the ability to distinguish between red and green. In people who have normal colour vision, some cones contain proteins that are sensitive to red and some contain proteins that are sensitive to green. However, in most forms of colour blindness, one of these types of cones does not contain the correct protein (e.g., "green cones" contain proteins that are sensitive to wavelengths of light that produce the colour red). Most forms of colour blindness are genetic in origin.

There are also visual disorders caused by the shape of the eye itself. Changes to the shape of the eye sometimes prevent a focused image from reaching the photoreceptors in the retina. *Nearsightedness*, or *myopia*, occurs when the eyeball is slightly elongated, causing the image that the cornea and lens focus on to fall short of the retina (see Figure 4.16). People who are nearsighted can see objects that are relatively close up but have difficulty focusing on distant objects. Alternatively, if the length of the eye is shorter than normal, the result is *farsightedness* or *hyperopia*. In this case, the image is focused *behind* the retina. Farsighted people can see distant objects clearly but not those that are close by. Both types of impairments can be corrected with contact lenses or glasses, thus allowing a focused visual image to stimulate the retina at the back of the eye, where light energy is converted into neural impulses.

Figure 4.16 Nearsightedness and Farsightedness



Nearsightedness and farsightedness result from misshapen eyes. If the eye is elongated or too short, images are not centred on the retina.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, Books A La Carte Edtion, 2nd ed. ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

In the past 20 years, an increasing number of people have undergone laser eye surgery in order to correct near- or farsightedness. In this type of surgery, surgeons use a laser to reshape the cornea so that incoming light focuses on the retina, which produces close to perfect vision. In nearsighted patients, the doctors attempt to flatten the cornea, whereas in farsighted patients the doctors attempt to make the cornea steeper. Although the idea of having a laser fire into your eyes sounds frightening, approximately 95% of the patients who undergo these surgeries report being completely satisfied with the results (Hashmani et al., 2017). Seeing is believing.

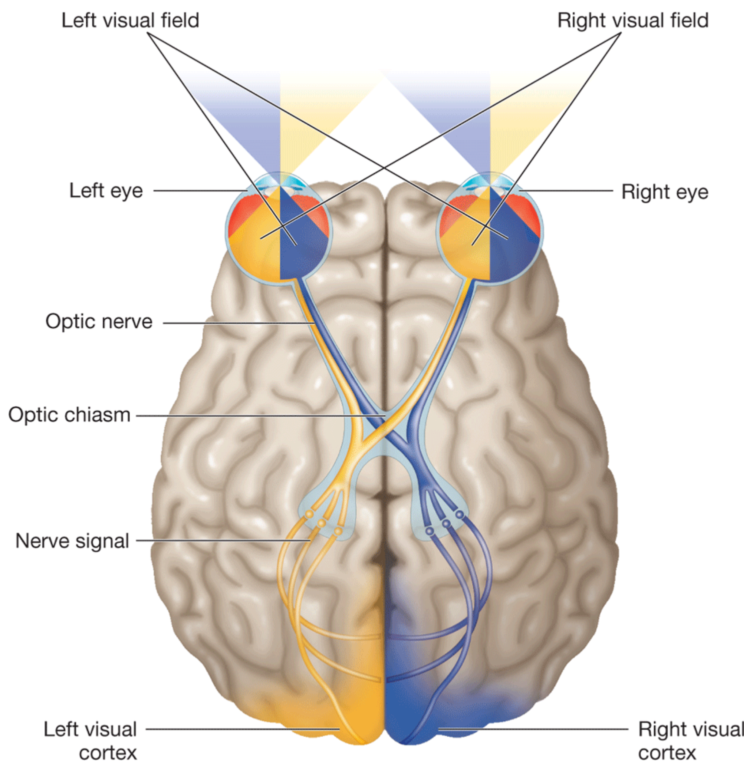
It is important to remember that the initial sensations of light that are processed in the eye itself provide very specific information about the environment that we are viewing. But, in order for this raw sensory information to be perceived, it needs to exit the eye and enter the brain.

Visual Perception and the Brain

Listen to the Audio

Information from the optic nerve travels to numerous areas of the brain. The first major destination is the **optic chiasm**, the point at which the optic nerves cross at the midline of the brain (see Figure 4.17). For each optic nerve, about half of the nerve fibres travel to the same side of the brain (ipsilateral), and half of them travel to the opposite side of the brain (contralateral). As can be seen in Figure 4.17, the outside half of the retina (closest to your temples) sends its optic nerve projections ipsilaterally. In contrast, the inside half of the retina (closest to your nose) sends its optic nerve projections contralaterally. The result of this distribution is that the left half of your visual field is initially processed by the right hemisphere of your brain, whereas the right half of your visual field is initially processed by the left hemisphere of your brain. Although this system might sound like it was designed by someone who had had a few drinks, it serves important functions, particularly if a person's brain is damaged. In this case, having both eyes send *some* information to both hemispheres increases the likelihood that *some* visual abilities will be preserved.

Figure 4.17 Pathways of the Visual System in the Brain



The optic nerves route messages to the visual cortex. At the optic chiasm, some of the cells remain on the same side and some cross to the opposite side of the brain. This organization results in images appearing in the left visual field being processed on the right side of the brain, and images appearing in the right visual field being processed on the left side of the brain.

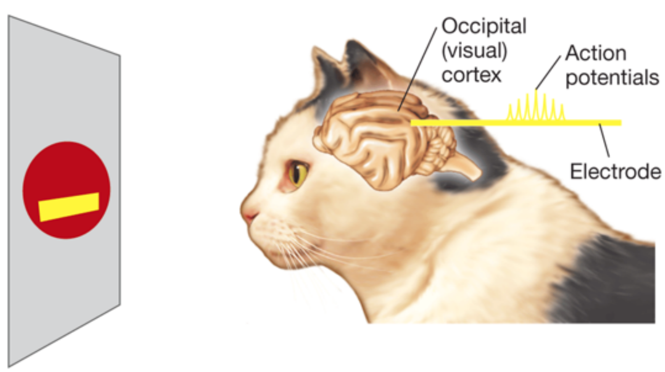
Source: Ciccarelli, Saundra K.; White, J. Noland, *Psychology*, 3rd Ed., ©2012, pp. 96. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Fibres from the optic nerve first connect with the thalamus, the brain's "sensory relay station." The thalamus is made up of over 20 different nuclei with specialized functions. The *lateral geniculate nucleus* is specialized for processing visual information. Fibres from this nucleus send messages to the visual cortex, located in the occipital lobe, where the complex processes of visual perception begin.

How does the visual cortex make sense of all this incoming information? It starts with a division of labour among specialized cells. One set of cells in the visual cortex—first discovered by Canadian David Hubel and his

colleague Torsten Wiesel in 1959—are referred to as **feature detection cells**; these cells respond selectively to simple and specific aspects of a stimulus, such as angles and edges (Hubel & Wiesel, 1962). Researchers have been able to map which feature detection cells respond to specific aspects of an image by measuring the firing rates of groups of neurons in the visual cortex in lab animals (Figure 4.18). Feature detection cells of the visual cortex are thought to be where visual input is organized for perception; however, additional processing is required for us to accurately perceive our visual world. From the primary visual cortex, information about different features is sent for further processing in the surrounding secondary visual cortex. This area consists of a number of specialized regions that perform specific functions, such as the perception of colour and movement. These regions begin the process of putting together primitive visual information into a bigger picture.

Figure 4.18 Measuring the Activity of Feature Detection Cells



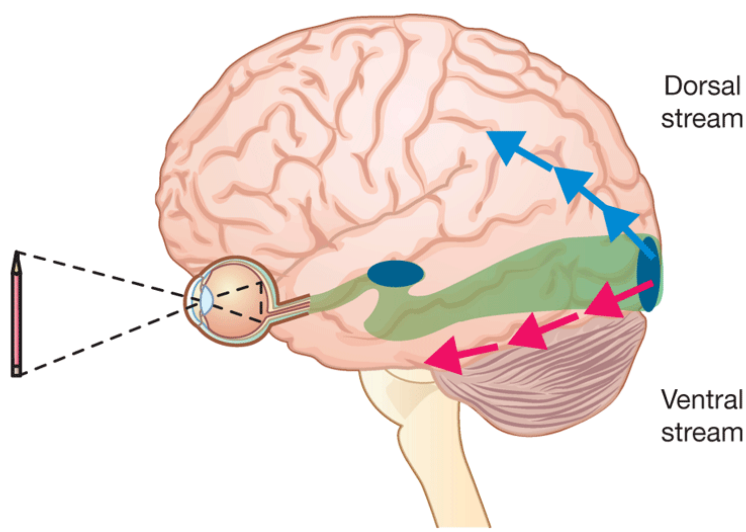
Researchers have been able to map which feature detection cells respond to specific aspects of an image by investigating the visual cortex in animals. This is done by doing single neuron recordings in the visual cortex while the subject views stimuli of varying patterns of light/dark, shape, orientation and motion.

1 of 4 Previous Next

Source: Lilienfeld, Scott O.; Lynn, Steven; Namy, Laura L.; Woolf, Nancy J., *Psychology: From Inquiry to Understanding*, Books A La Carte Edition, 2nd Ed., © 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

These specialized areas are the beginning of two streams of vision, each of which performs different visual functions (see Figure 4.19). The **ventral stream** extends from the visual cortex to the lower part of the temporal lobe. The **dorsal stream**, on the other hand, extends from the visual cortex to the parietal lobe. Both streams are essential for our ability to function normally in our visual world.

Figure 4.19 The Two Streams of Vision



Neural impulses leave the visual centres in the occipital lobe along two pathways. The ventral (bottom) stream extends to the temporal lobe and the dorsal (top) stream extends to the parietal lobe.

The Ventral Stream

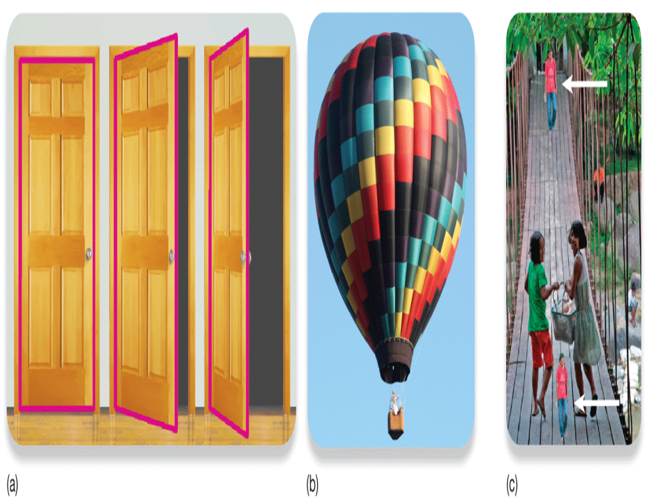
Listen to the Audio

The ventral stream of vision extends from the visual cortex in the occipital lobe to the anterior (front) portions of the temporal lobe. This division of our visual system performs a critical function: object recognition. Groups of neurons in the temporal lobe gather shape and colour information from different regions of the secondary visual cortex and combine it into a neural representation of an object. Brain imaging experiments have shown that damage to this stream of vision causes dramatic impairments in object recognition (James et al., 2003). Other studies have noted that different categories of objects—such as tools, animals, and instruments—are represented in distinct areas of the anterior temporal lobes (Tranel et al., 1997). Indeed, researchers have identified rare cases where brain-damaged individuals show a striking inability to name items from one category while being unimpaired at naming other categories (e.g., Caramazza & Mahon, 2003; Dixon et al., 1997); this deficit only affects the visual perception of those objects (e.g., a guitar), not the knowledge about those objects (e.g., that a guitar has six strings). But tools, animals, and musical instruments are not the only categories that are represented in distinct areas of the ventral stream of vision. One group of stimuli—possibly the most evolutionarily important one in our visual world—may have an entire region of the brain dedicated to its perception.

At this point in the module, we have looked at how we sense visual information and how this information is constructed by our brain-based

perceptual system into objects that can influence our behaviour, such as a face or an animal. But our visual system has even more tricks for us. Somehow, we can identify objects even when they are viewed in different lighting conditions or at different angles—your cat is still your cat, regardless of whether it is noon or midnight. This observation is an example of what is called **perceptual constancy**, *the ability to perceive objects as having constant shape, size, and colour despite changes in perspective*. What makes perceptual constancy possible is our ability to make relative judgments about shape, size, and lightness. For *shape constancy*, we judge the angle of the object relative to our position (see Figure 4.20). *Size constancy* is based on judgments of how close an object is relative to one's position as well as to the positions of other objects. *Colour constancy* allows us to recognize an object's colour under varying levels of illumination. For example, a bright red car is recognized as bright red whether in the shade or in full sunlight.

Figure 4.20 Perceptual Constancies



(a) Shape constancy: We perceive the door to be a rectangle despite the fact that the two-dimensional outline of the image on the retina is not always rectangular. (b) Colour constancy: We perceive colours to be constant despite changing levels of illumination. (c) Size constancy: The

person in the red shirt appears normal in size when in the background. A replica of this individual placed in the foreground appears unusually small because of size constancy.

Centre image: Brian Prawl/Shutterstock; right image: FORGET Patrick/SAGAPHOTO.COM/Alamy Stock photo
Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed. ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

The phenomenon of colour constancy recently gained international attention during "The Great Dress Debate" of 2015. As you may recall, a photograph of a dress became an international sensation when different people perceived it as being either blue and black or white and gold. A large-scale survey involving over 1400 respondents found that 57% of people perceived the dress as black and blue, 30% saw it as white and gold, 10% saw it as blue and brown, and 10% readily switched between colours (Lafer-Sousa et al., 2015). These striking differences in how different people perceived the dress captured the attention of both the general public and vision experts. Researchers quickly noted that colour constancy was a key factor in determining how the dress was perceived. When we view an object, we naturally try to account for the quality of the surrounding light. If we view something at dawn, our visual system attempts to discount some of the redness of objects because we know that sunrise makes everything appear redder than normal. It turns out that there are individual biases in which types of light people tend to discount. Individuals with a tendency to discount bluish light will perceive the dress as white and gold, whereas individuals who discount yellowish light will perceive the dress as blue and black (Brainard & Hurlbert, 2015; Gegenfurtner et al., 2015). Thus, "the dress" helps us demonstrate that our perceptual biases, along with our previous experiences and expectations, help structure and organize our visual experiences.

Indeed, all types of perceptual constancy are influenced by our previous experience with the objects as well as the presence of other objects that

can serve as comparisons. In other words, constancies are affected by top-down processing (see Module 4.1). If we know that a golden retriever is 60 cm tall or that a door is rectangular (or that a dress is blue and black), our visual system will use this knowledge when it organizes our perceptions in the brain. This top-down processing is also important when we have to decide how we plan to interact with the objects we are perceiving, a function performed by the dorsal stream of our visual system.

Working the Scientific Literacy Model

Are Faces Special?

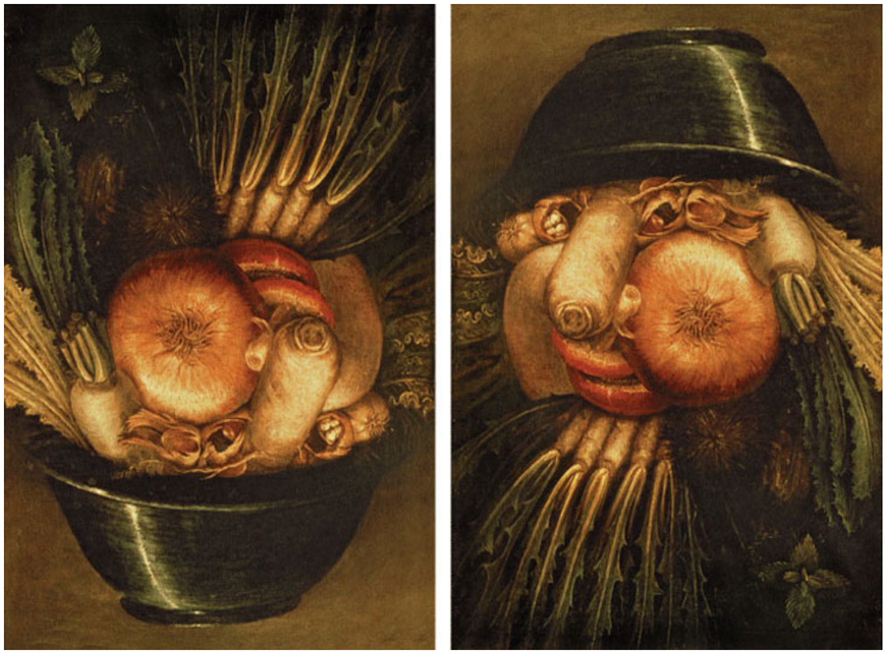
Listen to the Audio

Faces provide us with an incredible amount of social information. In addition to using faces to identify specific people, we can use them as a source of important social information, such as someone's emotional state. Other people's faces could therefore give you hints as to how you should respond to them, or to the situation you are both in. Given their importance, it seems logical that faces would be processed differently than many less important types of visual stimuli.

What do we know about face perception?

Look at the painting in Figure 4.21. What do you see? When you look at the image on the left, you will likely see a somewhat dreary bowl filled with vegetables. However, when most people see the image on the right, they perceive a face. They can obviously tell that the "face" is just the bowl of vegetables turned upside down, but the different items in the bowl do resemble the general shape of a face. The Italian artist Giuseppe Arcimboldo produced a number of similar paintings in which "faces" could be perceived within other structures. What Archimboldo was highlighting was the fact that faces appear to stand out relative to other objects in our visual world.

Figure 4.21 Seeing Faces



At left is a painting of turnips and other vegetables by the Italian artist Giuseppe Arcimboldo. The image at right is the same image rotated 180 degrees—does it resemble a human face?

Source: *The Vegetable Gardener*, c.1590 (oil on panel), Arcimboldo, Giuseppe (1527–93)/Museo Civico Ala Ponzone, Cremona, Italy/Bridgeman Images.

How can science explain how we perceive faces?

Not everyone sees the faces in Arcimboldo's painting. In fact, some neurological patients don't see faces at all. Specific genetic problems or brain damage can lead to an inability to recognize faces, a condition known as **prosopagnosia**, or face blindness. People with face blindness are able to recognize voices and other defining features of individuals (e.g., Angelina Jolie's lips), but not faces. Importantly, these patients tend to have damage or dysfunction in the same general area of the brain: the bottom of the right temporal lobe. So, although prosopagnosia is a relatively rare clinical condition, it does help us understand some basic processes that are involved in perceiving faces.

Brain imaging studies have corroborated the location of the "face area" of the brain (Kanwisher & Yovel, 2006). Using fMRI, researchers have consistently detected activity in this region, now known as the *fusiform face area (FFA)*. The FFA responds more strongly to the entire face than to individual features; unlike other types of stimuli, faces are processed holistically rather than as a nose, eyes, ears, chin, and so on (Tanaka & Farah, 1993). However, the FFA shows a much smaller response when we perceive *inverted* (upside down) faces. In this case, people tend to perceive the individual components of the face (e.g., eyes, mouth, and so on) rather than perceiving the faces as a holistic unit. Figure 4.22 provides an interesting—and somewhat jarring—visual phenomenon demonstrating this difference in our perception of upright and inverted faces.

Figure 4.22 The Face Inversion Effect

After viewing both upside-down faces, you probably noticed a difference between the two pictures. The face on the left probably seemed as a bit "off." Now turn your screen upside down and notice how the distortion of one of the faces is amplified when

viewed from this perspective. The reason the distorted face didn't seem as bizarre when viewed upside down is that you likely focused on the individual components of Beyoncé's face, none of which are strange on their own. When you viewed the stimuli as upright faces, you would have put the different features together into a more holistic view of Beyoncé's entire face. At this point, the distorted face would definitely not look flawless.

PA Photos/Landov

Interestingly, the FFA is also active when we perceive images of faces in everyday objects, such as when people see images of Jesus in a piece of toast (Liu et al., 2014). The fact that these illusory perceptions of faces, known as *face pareidolia*, also activate the FFA suggests that this structure is influenced by top-down processing that treats any face-like pattern as a face.

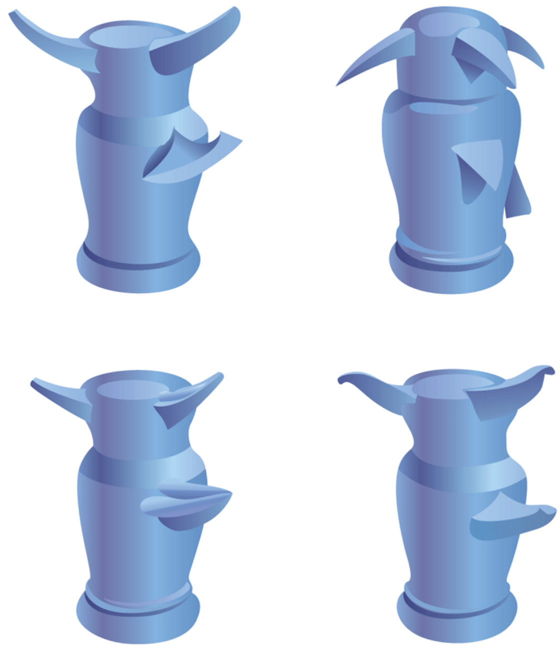
World-renowned chimpanzee researcher Jane Goodall has face blindness (prosopagnosia). Despite being face blind, Dr. Goodall and others with this condition use non-facial characteristics to recognize people, or, in her case, hundreds of individual chimpanzees (Goodall & Berman, 1999).

United Archives GmbH/Alamy Stock Photo

Can we critically evaluate this evidence?

Although no one doubts that faces are processed by the FFA, there are alternative explanations for these effects. One possibility is that the FFA is being activated by one of the cognitive or perceptual processes that help us perceive faces rather than by the perception of faces themselves. One such process is expertise. We are all experts at recognizing faces. Think of all of the people that you've gone to school with over the years. Think of all of the entertainers, athletes, and politicians you can recognize. You have the ability to distinguish among thousands of faces. Canadian psychologist Isabel Gauthier and her colleagues have suggested that face recognition isn't all that special. Instead, the FFA may simply be an area related to processing stimuli that we have become experts at recognizing (Gauthier, 2018). To test this hypothesis, she trained undergraduate students to recognize different types of a novel group of objects called Greebles (see Figure 4.23). Before training, these stimuli did not trigger activity in the FFA; however, after training, this area did become active (Gauthier et al., 1999). Further support for this expertise hypothesis comes from studies of bird and car experts (Gauthier et al., 2000). Both groups showed greater levels of brain activity in the FFA in response to stimuli related to their area of expertise (e.g., cars for car enthusiasts). Although this research doesn't negate the studies showing face-specific processing in this area, it does suggest that more research is necessary to see just how specialized this region of the ventral stream of vision really is.

Figure 4.23 Expertise for Faces and "Greebles"



These images are Greebles, faceless stimuli used to test whether the FFA responds only to faces (Gauthier & Tarr, 1997). Participants in these studies are taught to classify the Greebles on a number of characteristics such as “male” and “female.” Although this task seems difficult, after several training sessions participants can rapidly make such a decision. These “Greeble experts” also show increased activity in the region of the brain associated with processing faces.

Source: Expertise and the Fusiform Face Area. Reprinted with permission of Dr. Isabel Gauthier.

Why is this relevant?

The fact that a specific brain region is linked with the perception of faces is very useful information for neurologists and emergency room physicians. If a patient has trouble recognizing people, it could be a sign that he has damage to the bottom of the right temporal lobe. Indeed, based on studies of prosopagnosia, tests of face memory are now part of most assessment tools used by doctors and researchers. The fact that fMRI studies corroborate the location of the FFA increases our confidence that such tools are in fact valid.

The Dorsal Stream

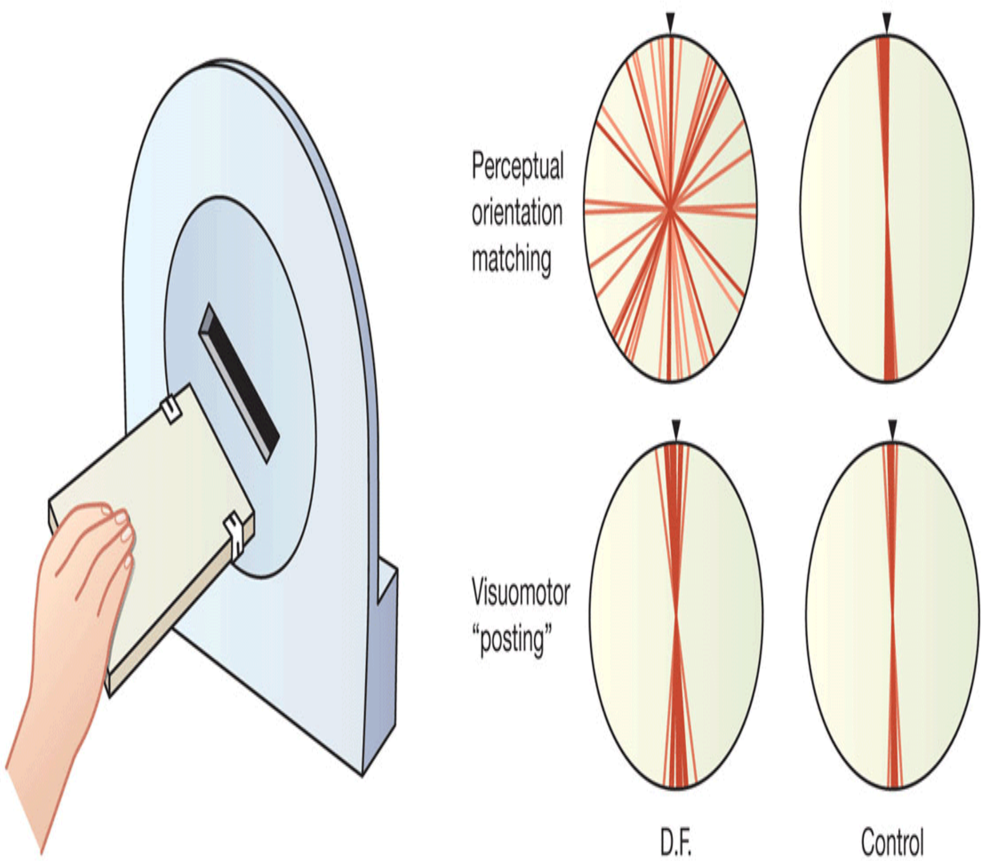
Listen to the Audio

The dorsal stream of vision extends from the visual cortex in our occipital lobe upwards to the parietal lobe. Its function is less intuitive than that of the ventral stream, but is just as important. Imagine looking at your morning cup of coffee sitting on the table you're working at. You immediately recognize that the object is a cup, and that the liquid inside of it is coffee, something you drink. You also decide that it is time to have a sip, thus requiring your arm to move so that your hand can grasp the mug of caffeinated goodness. Someone with a healthy brain can do this effortlessly. However, someone with damage to the dorsal stream of vision would have great difficulty performing this simple function. How can we explain this impairment?

Leslie Ungerleider and Mortimer Mishkin (1982) suggested that the ventral and dorsal stream of vision could be referred to as the "what" and "where" pathways. The ventral stream identifies the object, and the dorsal stream locates it in space and allows you to interact with it. Although this description is accurate, researchers at Western University have suggested that the function of the "where" pathway is more specific (Goodale et al., 1991; Milner & Goodale, 2006). Their initial research was based on studies involving a patient known as "D.F." (in order to preserve patients' anonymity, their names are never provided in research papers). D.F. was a healthy middle-aged woman who suffered damage to her temporal lobe that interfered with the ventral stream of vision. As a result, her ability to recognize objects was severely impaired; indeed, she could not recognize

letters or line drawings. However, she could still reach for objects as though she had perfect vision. For instance, when asked to put a letter in a mailbox, she was able to do so, even if the angle of the mail slot was changed by a sneaky researcher (see Figure 4.24). Goodale and colleagues correctly hypothesized that D.F.'s dorsal stream was preserved, and that this pathway was involved with *visually guided movement*. So, the next time you reach out to grab your caffeinated beverage from the table, remember that the "simple" ability to recognize and reach for the object requires multiple pathways in the brain.

Figure 4.24 Testing the Dorsal Stream



Patient D.F. was able to rotate her hand to fit an envelope into a mail slot despite having difficulties identifying either object. Her preserved dorsal stream of vision allowed her to use vision to guide her arm's motions.

Source: Reprinted by permission from Melvyn A. Goodale.

Depth Perception

Listen to the Audio

Our ability to use vision to guide our actions is dependent on our depth perception. We need to be able to gauge the distances between different objects as well as to determine where different objects are located relative to each other. Without this ability, it would be difficult to return a tennis serve, drive a car, or even walk through a crowded university hallway. Information related to depth perception can be detected in a number of ways.

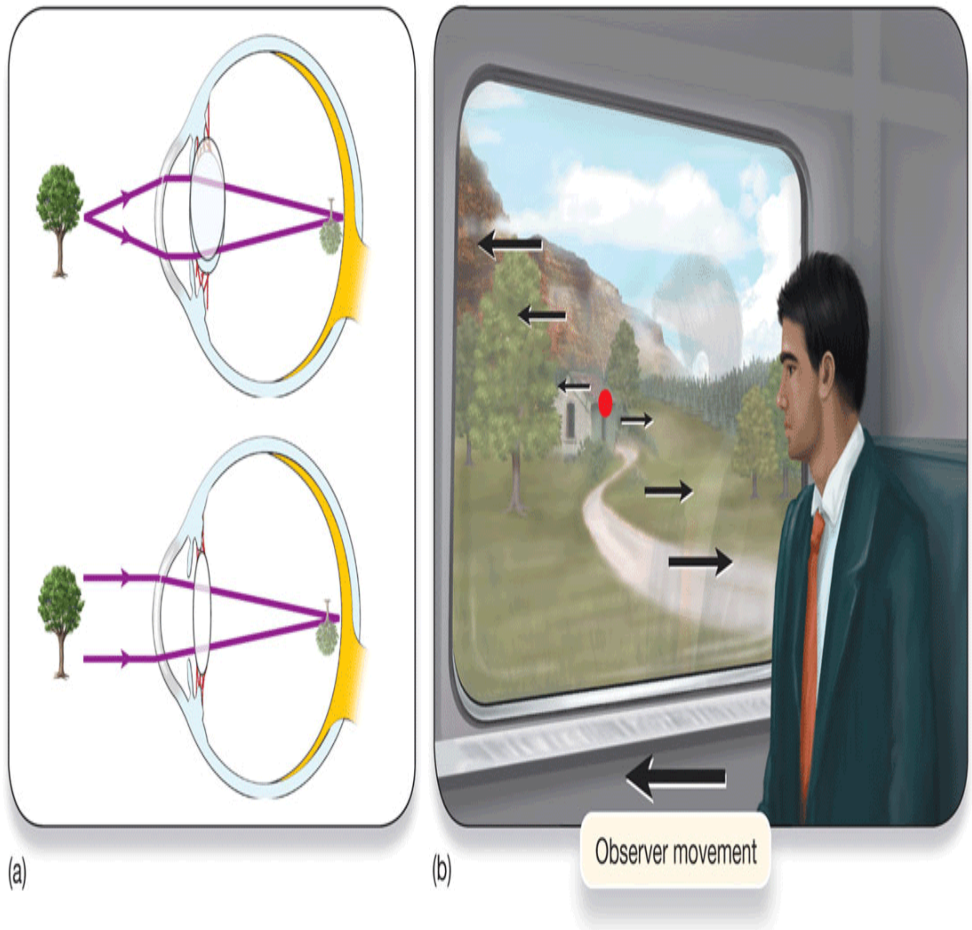
Binocular depth cues *are distance cues that are based on the differing perspectives of both eyes*. One type of binocular depth cue, called **convergence**, *occurs when the eye muscles contract so that both eyes focus on a single object*. Convergence typically occurs for objects that are relatively close to you. For example, if you move your fingertip toward your nose, your eyes will move inward and will turn toward each other. The sensations that occur as these muscles contract to focus on a single object provide the brain with additional information used to create the perception of depth.

One reason humans have such a fine-tuned ability to see in three dimensions is that both of our eyes face forward. This arrangement means that we perceive objects from slightly different angles, which in turn enhances depth perception. For example, choose an object in front of you, such as a pen held at arm's length from your body, and focus on that object with one eye while keeping the other eye closed. Then open your

other eye to look at the object (and close the eye you were just using). You will notice that the position of your pen appears to change. This effect demonstrates **retinal disparity** (also called binocular disparity), *the difference in relative position of an object as seen by both eyes, which provides information to the brain about depth*. Your brain relies on cues from each eye individually and from both eyes working in concert—that is, in stereo. Most primates, including humans, have *stereoscopic vision*, which results from overlapping visual fields. The brain can use the difference between the information provided by the left and right eye to make judgments about the distance of the objects being viewed. Species that have eyes with no overlap in their visual field, such as some fish, likely do not require as much depth information in order to survive in their particular environment. These species might also be able to make use of depth information perceived by each eye individually.

Monocular cues *are depth cues that we can perceive with only one eye*. We have already discussed one such cue, called *accommodation*, earlier in this module. During accommodation, the lens of your eye curves to allow you to focus on nearby objects. Close one eye and focus on a nearby object, and then slightly change your focus to an object that is farther away; the lens changes shape again so the next object comes into focus (see Figure 4.25a). The brain receives feedback about this movement that it can then use to help make judgments about depth. Another monocular cue is *motion parallax*; it is used when you or your surroundings are in motion (see Figure 4.25b). For example, as you sit in a moving vehicle and look out of the passenger window, you will notice objects closer to you, such as the roadside, parked cars, and nearby buildings, appear to move rapidly in the opposite direction of your travel. By comparison, far-off objects such as foothills and mountains in the distance appear to move much more slowly, and in the same direction as your vehicle. The disparity in the directions travelled by near and far-off objects provides a monocular cue about depth.

Figure 4.25 Two Monocular Depth Cues



(a) Accommodation. From the top-left image light comes from a distant object, and the lens focuses the light on the retina. From the bottom-left image the lens changes shape to *accommodate* the light when the same object is moved closer. (b) Motion parallax. As you look out the train window, objects close to you race past quickly and in the opposite direction that you are headed. At the same time, distant objects appear to move slowly and in the same direction that you are travelling.

Psych@

The Artist's Studio

Although we may think of painters as eccentric people prone to cutting off their ears, they are actually very clever amateur vision scientists. Rembrandt (1606–1669) varied the texture and colour details of different parts of portraits in order to guide the viewer's gaze toward the clearest object. The result is that more detailed regions of a painting attract attention and receive more eye fixations than less detailed areas (DiPaola et al., 2011).

In addition to manipulating a viewer's eye movements, painters also use a variety of depth cues to transform their two-dimensional painting into a three-dimensional perception. This use of *pictorial depth cues* is quite challenging, which is why some paintings seem vibrant and multilayered (like nature) while others seem flat and artificial. So what are some strategies that artists use to influence our visual perception?

To understand how artists work, view the painting by Gustave Caillebotte shown in Figure 4.26. In this painting, you will notice that the artist used numerous cues to depict depth:

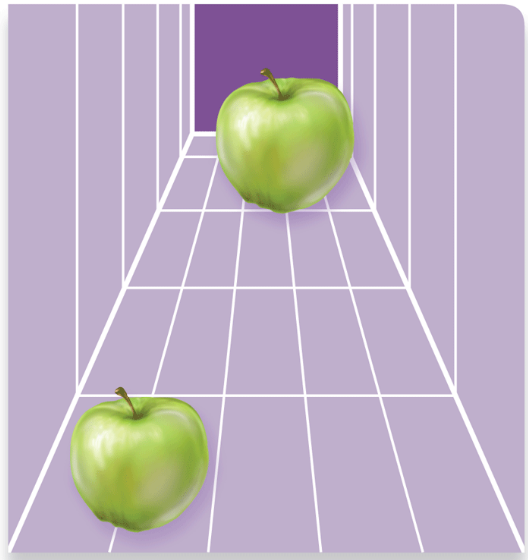
Figure 4.26 Pictorial Depth Cues

Artists make use of cues such as linear perspective, texture gradient, relative size, and others to create the sense of depth.

Source: Sketch for *Paris, a Rainy Day*, 1877 (oil on canvas), pre-restoration (see 181504), Caillebotte, Gustave (1848–94)/Musee Marmottan Monet, Paris, France/Bridgeman Images.

- *Linear perspective:* Parallel lines stretching to the horizon appear to move closer together as they travel farther away. This effect can be seen in the narrowing of the streets and the converging lines of the sidewalks and the top of the building in the distance. This effect is nicely demonstrated by the illusion in Figure 4.27.

Figure 4.27 The Corridor Illusion



Linear perspective and height in plane create the perception of depth here. The result is that the object at the “back” of the drawing appears to be larger than the one in the foreground; in reality, they are identical in size.

- *Interposition:* Nearby objects block our view of far-off objects, such as the umbrellas blocking the view of buildings behind them.
- *Light and shadow:* The shadow cast by an object allows us to detect both the size of the object and the relative locations of objects. In addition, closer objects reflect more light than far-away objects.
- *Texture gradient:* Objects that are coarse and distinct at close range become fine and grainy at greater distances. In the painting, for example, the texture of the brick street varies from clear to blurred as distance increases.
- *Height in plane:* Objects that are higher in our visual field are perceived as farther away than objects low in our visual field. The base of the main building in the background of the painting is at about the same level as the man’s shoulder, but we interpret this effect as distance, not as height.

- *Relative size:* If two objects in an image are known to be of the same actual size, the larger of the two must be closer. This can be seen in the various sizes of the pedestrians.

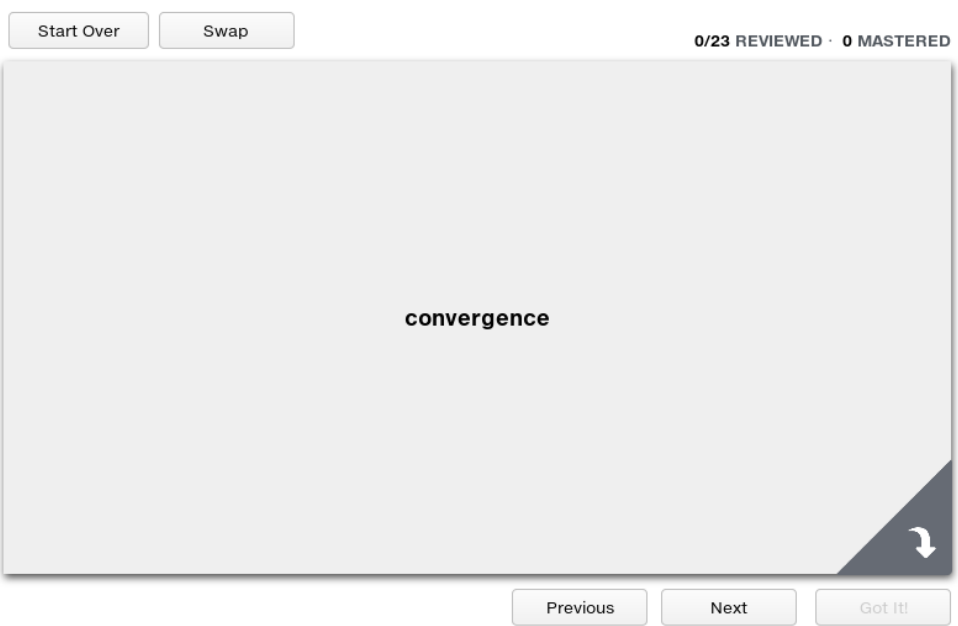
Interestingly, Harvard neurobiologists recently speculated that Rembrandt suffered from “stereo blindness,” an inability to form binocular images (Livingstone & Conway, 2004). He would therefore have had to rely on monocular cues to form the perceptions that led to his innovative depictions of the visual world.

Module 4.2 Summary

Listen to the Audio

4.2a Know . . . the key terminology relating to the eye and vision.

Review Module 4.2



4.2b Understand . . . how visual information travels from the eye through the brain to give us the experience of sight.

Light is transformed into a neural signal by photoreceptors in the retina. This information is then relayed via the optic nerve through the thalamus

and then to the occipital lobe of the cortex. From this location in the brain, neural circuits travel to other regions for specific levels of processing. These include the temporal lobe for object recognition (the ventral stream) and the parietal lobe for visually guided movement (the dorsal stream).

4.2c Understand . . . the theories of colour vision.

The two theories reviewed in this module are the trichromatic and opponent-process theories. According to trichromatic theory, the retina contains three different types of cones that are sensitive to different wavelengths of light. Colour is experienced as the net combined stimulation of these receptors. The trichromatic theory is not supported by phenomena such as the negative afterimage. Opponent-process theory, which emphasizes how colour perception is based on excitation and inhibition of opposing colours (e.g., red–green, blue–yellow, white–black), explains this phenomenon. Taken together, both theories help explain how we perceive colour.

4.2d Apply . . . your knowledge to explain how we perceive depth in our visual field.

Apply Activity

For practice, take a look at the accompanying photo. Can you identify at least four monocular depth cues that are present in the image below?

Thinkstock/Stockbyte/Getty Images

4.2e Analyze . . . how we perceive objects and faces.

Object perception is accomplished by specialized perceptual regions of the temporal lobe (the ventral stream of vision). Damage to this region can lead to impairments in recognizing specific categories of objects. Facial recognition is a specialized perceptual process, which is supported by evidence from people who are face blind but are otherwise successful at recognizing objects. A region of the temporal lobe has been identified that supports this perceptual specialization, though it may also be involved in recognizing other types of familiar objects.

Module 4.3 The Auditory and Vestibular Systems

Listen to the Audio

Tomas Hudolin/Shutterstock

Learning Objectives

4.3a Know . . . the key terminology relating to the ear, hearing, and the vestibular system.

4.3b Understand . . . different characteristics of sound and how they correspond to perception.

4.3c Understand . . . how the vestibular system affects our sense of balance.

4.3d Apply . . . your knowledge of sound localization.

4.3e Analyze . . . how musical beats are related to movement.

Imagine watching an action movie like Black Panther in a movie theatre with Dolby™ Surround Sound. Your body would feel the powerful sound waves from the explosions and accelerating aircraft. Now imagine watching a scary movie with a killer in a Halloween mask chasing a young couple through the woods. The music becomes louder and faster, adding anxiety and emotion to the scene. Now imagine watching these movies with the sound muted. You'll have lost more than the sound waves. . .

Sounds have a dramatic effect on our experience of movies (and, to a lesser extent, television). Paramount among these is music. For example, can you imagine Star Wars *without the familiar John Williams theme, or a horror movie without tension-inducing music? The movies would lose their emotional impact almost immediately. This is because music perception activates regions of the brain related to emotional perception (Bhatara et al., 2011; Gosselin et al., 2005). Indeed, in a novel study, researchers at the Université de Montréal and Concordia University found that patients with damage to the amygdala, an area of the brain related to the experience of fear, were impaired in their ability to recognize that particular pieces of music, such as the theme to* Jaws, *were scary. Studies such as this imply that in*

healthy brains, the emotion centres respond during the perception of music in order to help us understand its meaning. They also show us how important the auditory system is to how we experience our world.

In this module we will explore characteristics of sound, the physical structures that support the sensation of sound, and the pathways involved in its perceptual processing. We will also examine how music affects memory and emotion, and how this relationship can influence our behaviour.

Sound and the Structures of the Ear

Listen to the Audio

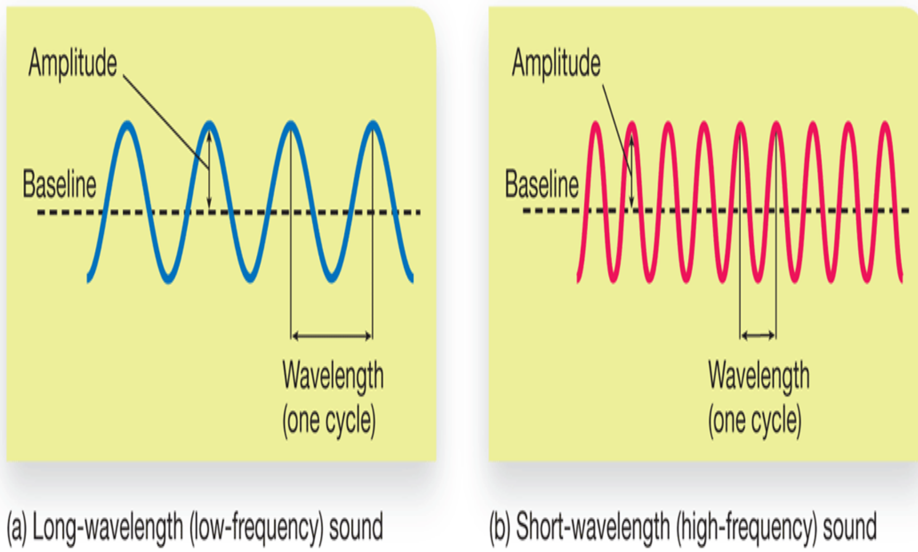
The function of the ear is to gather sound waves. The function of *hearing* is to extract some sort of meaning from those sound waves; this meaning informs you about the nature of the sound source, such as someone calling your name, a referee's whistle, or a vehicle coming toward you. How do people gain so much information from invisible waves that travel through the air?

Sound

Listen to the Audio

The function of that remarkably sensitive and delicate device, the human ear, is to detect *sound waves* and to transform them into neural signals. Sound waves are simply changes in mechanical pressure transmitted through solids, liquids, or gases. Sound waves have two important characteristics: frequency and amplitude (see Figure 4.28). *Frequency* refers to wavelength and is measured in hertz (Hz), the number of cycles a sound wave travels per second. **Pitch** *is the perceptual experience of sound wave frequencies*. High-frequency sounds, such as tires screeching on the road, have short wavelengths and a high pitch. Low-frequency sounds, such as those produced by a bass guitar, have long wavelengths and a low pitch. The *amplitude* of a sound wave determines its loudness: High-amplitude sound waves are louder than low-amplitude waves. Both types of information are gathered and analyzed by our ears.

Figure 4.28 Characteristics of Sound: Frequency and Amplitude

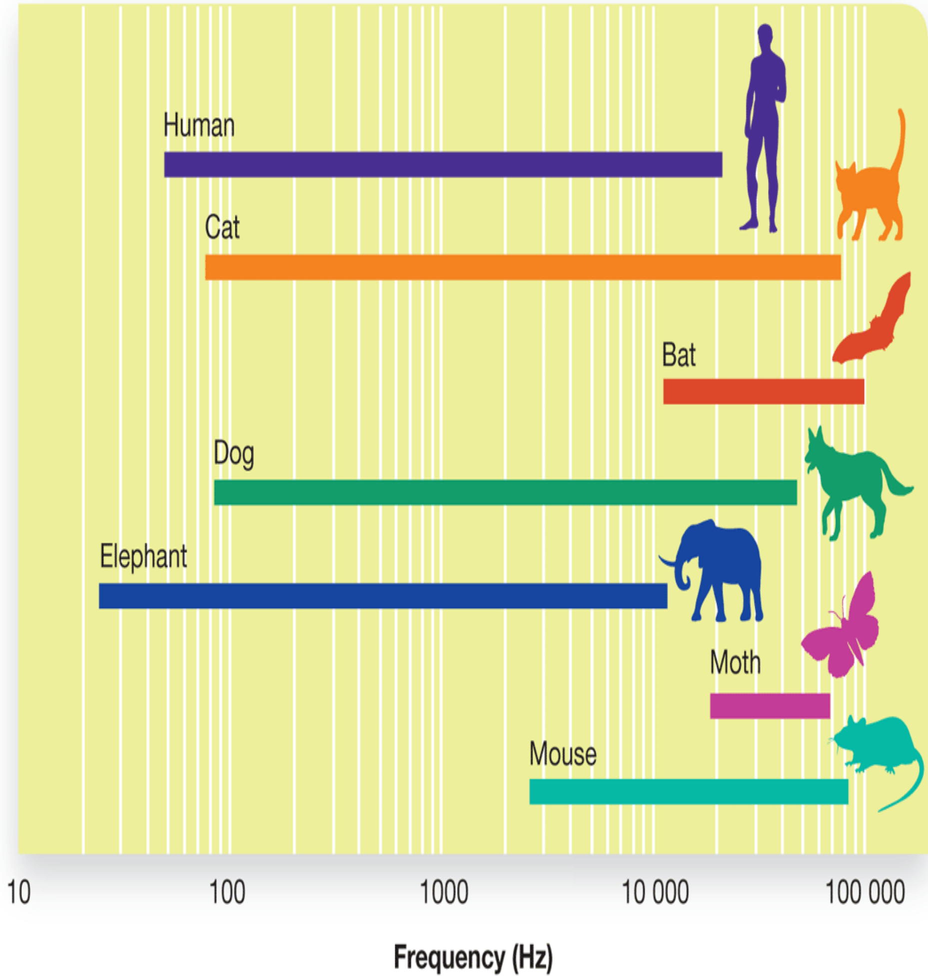


The frequency of a sound wave (cycles per second) is associated with pitch, while amplitude (the height of the sound wave) is associated with loudness.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed. ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Humans are able to detect sounds in the frequency range from 20 Hz to 20 000 Hz. Figure 4.29 compares the hearing ranges of several species. Look closely at the scale of the figure—the differences are of a much greater magnitude than could possibly fit on this page using a standard scale. The comparisons show that mice, for example, can hear frequencies close to five times greater than humans but have difficulty hearing lower frequencies that we can easily detect.

Figure 4.29 A Comparison of Hearing Ranges in Several Species



Source: Based on Fay, R. R. (1988) and Warfield, D. (1973).

Loudness—a function of sound wave amplitude—is typically expressed in units called decibels (dB). Table 4.2 compares decibel levels ranging from nearly inaudible to injury inducing. Although we doubt you spend much time beside jet engines, we do suggest wearing earplugs to concerts to protect your ears, even if they don't match your always-stylish "I'm a Belieber" T-shirt.

Table 4.2 Decibel Levels for Some Familiar Sounds

Table 4.2 Decibel Levels for Some Familiar Sounds

Sound	Noise Level (dB)	Effect
Jet engines (near)	140	We begin to feel pain at about 125 dB.
Rock concerts (varies)	110–140	
Thunderclap (near)	120	Regular exposure to sound over 100 dB for more than one minute risks permanent hearing loss.
Power saw (chainsaw)	110	
Garbage truck/Cement mixer	100	No more than 15 minutes of unprotected exposure is recommended for sounds between 90 and 100 dB.
Motorcycle (25 ft)	88	85 dB is the level at which hearing damage (after eight hours) begins.
Lawn mower	85–90	
Average city traffic	80	Annoying; interferes with conversation; constant exposure may cause damage
Vacuum cleaner	70	Intrusive; interferes with telephone conversation
Normal conversation	50–65	Comfortable hearing levels are under 60 dB
Whisper	30	Very quiet
Rustling leaves	20	Just audible

Crowd noise can be a risk for hearing loss. One of the textbook authors (Smith) attended a Winnipeg Jets′ playoff game in which the noise level reached 111 decibels.

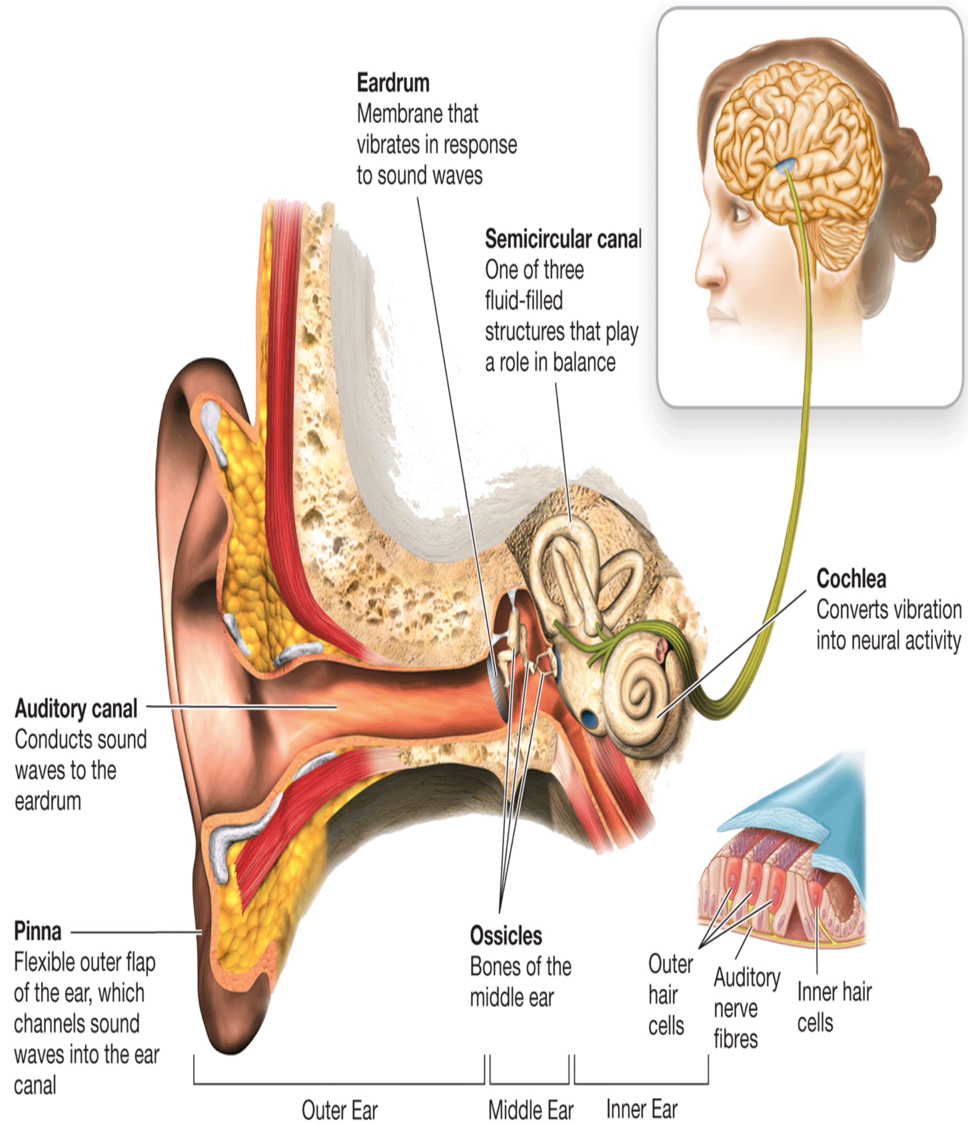
RENAULT Philippe/hemis.fr/Alamy Stock Photo

The Human Ear

Listen to the Audio

The human ear is divided into outer, middle, and inner regions (see Figure 4.30). The most noticeable part of your ear is the *pinna*, the outer region that helps channel sound waves to the ear and allows you to determine the source or location of a sound. The *auditory canal* extends from the pinna to the eardrum. Sound waves reaching the eardrum cause it to vibrate. Even very soft sounds, such as a faint whisper, produce vibrations of the eardrum. The middle ear consists of three tiny moveable bones called *ossicles*, known individually as the malleus (hammer), incus (anvil), and stapes (stirrup). The eardrum is attached to these bones, so any movement of the eardrum due to sound vibrations results in movement of the ossicles.

Figure 4.30 The Human Ear



Sound waves travel from the outer ear to the eardrum and middle ear, and then through the inner ear. The cochlea of the inner ear is the site at which transduction takes place through movement of the tiny hair cells lining the basilar membrane. The auditory cortex of the brain is a primary brain region where sound is perceived.

The ossicles attach to an inner ear structure called the **cochlea**—*a fluid-filled membrane that is coiled in a snail-like shape and contains the structures that convert sound into neural impulses*. Converting sound vibrations to neural impulses is possible because of hair-like projections that line the

basilar membrane of the cochlea. The pressing and pulling action of the ossicles causes parts of the basilar membrane to flex. This causes the fluid within the cochlea to move, displacing these tiny hair cells. When hair cells move, they stimulate the cells that comprise the auditory nerves. The auditory nerves are composed of bundles of neurons that fire as a result of hair cell movements. These auditory nerves send signals to the thalamus—the sensory relay station of the brain—and then to the auditory cortex, located within the temporal lobes.

Watch The Structure of the Ear

As you might expect, damage to any part of the auditory system will result in hearing impairments. However, recent technological advances are allowing individuals to compensate for this hearing loss. *Cochlear implants* are now quite common and have been used to help tens of thousands of individuals regain some of their hearing. These devices typically consist of a small microphone that detects sounds from the outside world and electronically stimulates parts of the membranes in the cochlea (see Figure 4.31). Although these devices are not a perfect substitute for a normally functioning auditory system, they do allow individuals to hear low-frequency sounds such as those used in human

speech. These devices are particularly useful for young children (Fitzpatrick et al., 2011; Peterson et al., 2010), as the brains of children more easily form new pathways in response to the stimulation from the implants.

Figure 4.31 A Cochlear Implant

The speech processor and microphone are located just above the pinna. A wire with tiny electrodes attached is routed through the cochlea.

Carlos Osorio/Toronto Star/Getty Images

The Perception of Sound

Listen to the Audio

It is quite remarkable that we are able to determine what makes a sound and where the sound comes from by simply registering and processing sound waves. In this section we examine how the auditory system accomplishes these two tasks, starting with the ability to locate a sound in the environment.

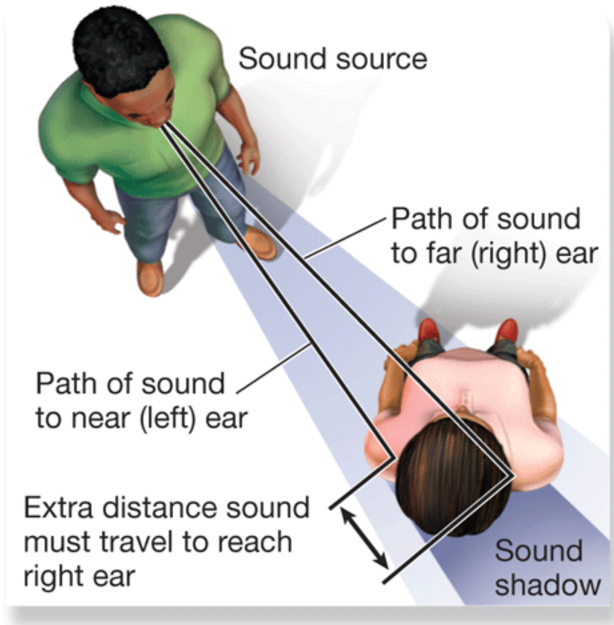
Sound Localization: Finding the Source

Listen to the Audio

Accurately identifying and orienting oneself toward a sound source has some obvious adaptive benefits. Over the course of evolution, failure to do so could result in an organism becoming someone else's dinner, or failing to catch dinner of one's own. Thus, auditory systems have developed to allow organisms, including humans, to orient toward sounds in the environment. This **sound localization**, *the process of identifying where sound comes from*, is handled by parts of the brainstem as well as by a midbrain structure called the *inferior colliculus*.

There are two ways that we localize sound. First, we take advantage of the slight time difference between a sound hitting both ears to estimate the direction of the source. If your friend shouts your name from your left side, the left ear will receive the information a fraction of a second before the right ear. Second, we localize sound by using differences in the intensity in which sound is heard by both ears—a phenomenon known as a *sound shadow* (Figure 4.32). If the source of the sound is to your left, the left ear will experience the sound more intensely than the right because the right ear will be in the sound shadow. Nuclei in the brainstem detect differences in the times when sound reaches the left versus the right ear (Carr & Konishi, 1990), as well as the intensity of the sound between one side and the other, allowing us to identify where it is coming from.

Figure 4.32 How We Localize Sound



To localize sound, the brain computes the small difference in time at which the sound reaches each of the ears. The brain also registers differences in loudness that reach both ears.

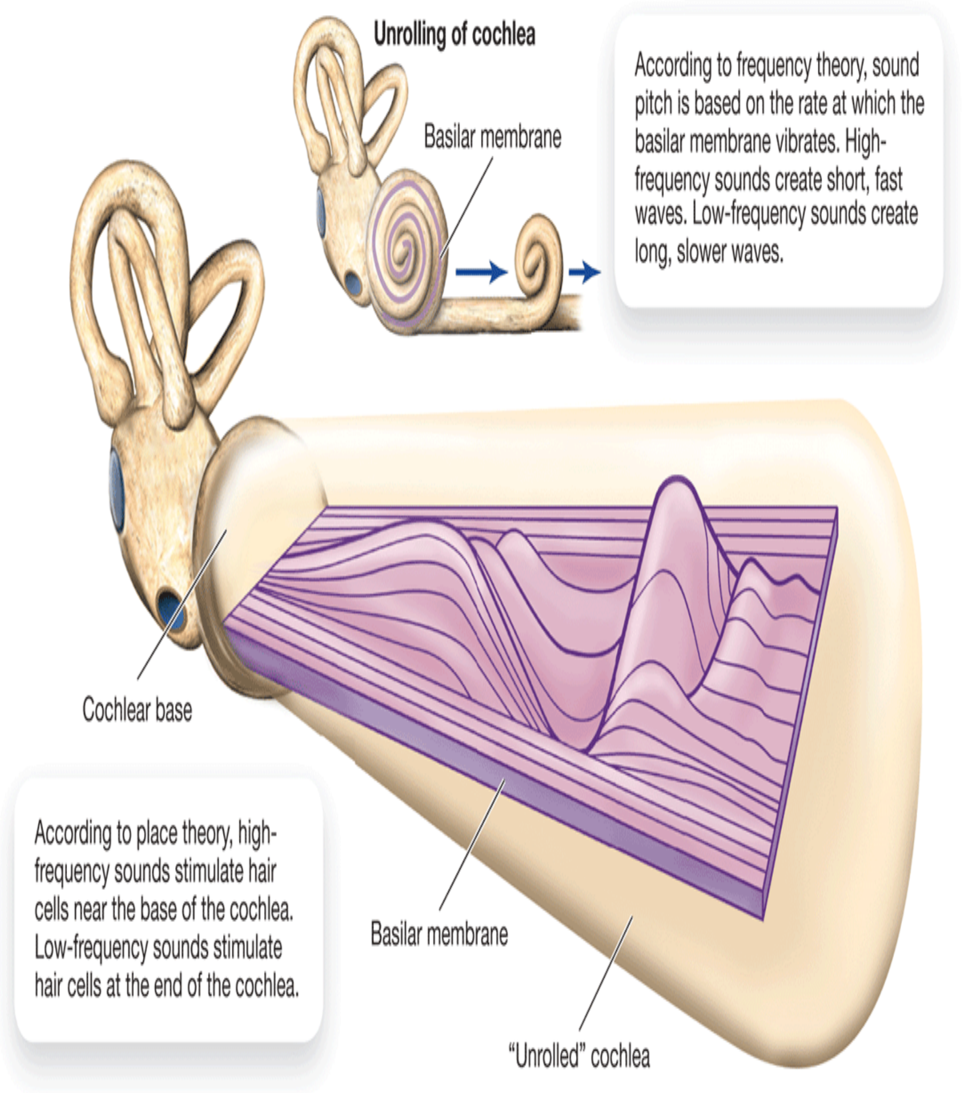
Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed. ©2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Theories of Pitch Perception

Listen to the Audio

To explain how we perceive pitch, we will begin in the cochlea and work toward brain centres that are specialized for hearing. How does the cochlea pave the way for pitch perception? One explanation involves the specific arrangement of hair cells along the basilar membrane. Not all hair cells along the basilar membrane are equally responsive to sounds within the 20 to 20 000 Hz range of human hearing. High-frequency sounds stimulate hair cells closest to the ossicles, whereas lower-frequency sounds stimulate hair cells toward the end of the cochlea (see Figure 4.33). Thus, *how we perceive pitch is based on the location (place) along the basilar membrane that sound stimulates*, a tendency known as the **place theory of hearing**.

Figure 4.33 The Basilar Membrane of the Cochlea and Theories of Hearing



Source: "A Cochlear Implant" (Fig. 3.9, p. 104) from *Psychology*, 3rd edition, by Saundra Ciccarelli & J. Noland White. Copyright © 2012. Printed and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

Another determinant of how and what we hear is the rate at which the ossicles press into the cochlea, sending a wave of activity down the basilar membrane. According to **frequency theory**, *the perception of pitch is related to the frequency at which the basilar membrane vibrates*. A 70-Hz sound stimulates the hair cells 70 times per second. Thus, 70 nerve impulses per second travel from the auditory nerves to the brain, which interprets the sound frequency in terms of pitch (Figure 4.33). However,

we quickly reach an upper limit on the capacity of the auditory nerves to send signals to the brain: Neurons cannot fire more than 1000 times per second. Given this limit, how can we hear sounds exceeding 1000 Hz? The answer lies in the *volley principle*. According to the volley principle, groups of neurons fire in alternating (hence the term *volley*) fashion. A sound measuring 5000 Hz can be perceived because groups of neurons fire in rapid succession (Wever & Bray, 1930).

Currently, the place, frequency, and volley theories are all needed to explain our experience of hearing. When we hear complex stimuli, such as music, the place, frequency, and volley principles are likely all functioning at the sensory level. However, turning this sensory information into the perception of music, voices, and other important sounds occurs in specialized regions of the brain.

Auditory Perception and the Brain

Listen to the Audio

The **primary auditory cortex** *is a major perceptual centre of the brain involved in perceiving what we hear*. The auditory cortex is organized in very similar fashion to the cochlea. Cells within different areas across the auditory cortex respond to specific frequencies. For example, high musical notes are processed at one end of the auditory cortex, and progressively lower notes are heard as you move to the opposite end (Wang, Lu, et al., 2005). As in the visual system, the primary auditory cortex is surrounded by brain regions that provide additional sensory processing. This *secondary auditory cortex* helps us to interpret complex sounds, including those found in speech and music. Interestingly, the auditory cortices in the two hemispheres of the brain are not equally sensitive. In most individuals the right hemisphere is able to detect smaller changes in pitch than the left hemisphere (Hyde et al., 2008). Given this fact, it is not surprising that the right hemisphere is also superior at detecting sarcasm, as this type of humour is linked to the tone of voice used (Voyer et al., 2008).

However, we are not born with a fully developed auditory cortex. In order to perceive our complex auditory world, the auditory cortices must *learn* to analyze different patterns of sounds. Researchers have identified a number of different changes in the brain's responses to sounds during the course of development. Brain imaging studies have shown that infants as young as three months of age are able to detect simple changes in pitch (He et al., 2007, 2009). Infants can detect silent gaps in a tone (an

ability that may help us learn languages) between the ages of four to six months (Trainor et al., 2003), and develop the ability to localize sound at approximately eight months of age (Trainor, 2010). By 12 months of age, the auditory system starts to become specialized for the culture in which the infant is living. Infants who are 10 to 12 months of age do not recognize sound patterns that are not meaningful in their native language or culture (Werker & Lalonde, 1988); indeed, children in this age group show different patterns of brain activity when hearing culturally familiar and unfamiliar sounds (Fujioka et al., 2011). This brain plasticity explains why many of us have difficulty hearing fine distinctions in the sounds of languages we are exposed to later in life. Interestingly, this fine-tuning of the auditory cortex also influences how we perceive music.

The Perception of Music

Listen to the Audio

Because our auditory systems have evolved to be able to distinguish between different rapidly changing pitches that are important for understanding speech, we also have a brain that is nicely designed for perceiving different elements of music, particularly the differences in sound frequencies that we perceive as pitch (Levitin, 2006). As noted in the previous section of this module, this function is performed by the primary auditory cortex in the temporal lobes. Our ability to compare different pitches also uses the secondary auditory cortex, the brain areas immediately in front of and behind the primary auditory cortex (Zatorre & Zarate, 2010). Both neuroimaging studies and studies with brain-damaged patients have shown that the auditory cortices in the right hemisphere are particularly sensitive to nuances in pitch (Hyde, Peretz, et al., 2008; Johnsrude et al., 2000).

However, music perception requires more than just perceiving different frequencies. It also uses one of the human brain's most amazing skills—the ability to organize information into a coherent structure or pattern.

Working the Scientific Literacy Model

The Perception of Musical Beats

Listen to the Audio

The next time you listen to music, concentrate on what you are thinking and on how your body is responding. Do you find yourself subtly moving with the music? Are you tapping your fingers or feet to the beat? Do you sing (or hum) along to the music? Most people are able to perform some or all of these musical responses, even if they have no musical training. In the past decade, psychologists have begun to unravel the perceptual and neural processes that allow us to do so.

What do we know about the perception of musical beats?

Our brains are pattern-recognition machines. In terms of music, this ability is most clearly shown by our ability to detect metrical structure, or groups of stronger and weaker events that we perceive as musical beats. When we listen to music, most people are able to detect the fact that certain patterns tend to repeat; as a result, our brains begin to expect beats to occur at specific times (Large & Palmer, 2002). This is the basis of our ability to detect musical beats or rhythms. As a result, we can tap our fingers to any song we hear on the radio, from Ariana Grande to Arcade Fire.

This ability to detect rhythms or beats appears to be innate—even babies can do it! In one study, babies were exposed to a series of musical beats. Babies showed distinct changes in brain activity when they heard sound files that skipped a beat (Winkler et al., 2008). Interestingly, this ability appears to be linked to motion. In an innovative study conducted at McMaster University, seven-month-old infants heard a two-minute musical piece that did not have a difference between a strong beat (e.g., a bass drum) and a weak beat (e.g., a cymbal). Some of the babies were bounced every second beat and some were bounced every third beat. During a later test, the babies heard versions of the music that stressed every second beat or every third beat. Overall, the babies showed behavioural preferences for the rhythms that matched the beats on which they were bounced (Phillips-Silver & Trainor, 2005). The fact that motion influences how humans perceive musical beats suggests that detection of these beats likely involves brain systems related to movement.

How can science explain the perception of musical beats?

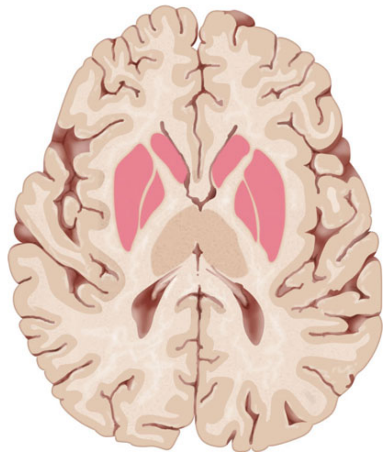
A number of brain imaging studies have shown that perceiving musical beats leads to activity in brain areas that are involved with coordinating movements (Merchant et al., 2015). For example, researchers noted that individual differences in the ability to detect musical beats are linked to differences in activity in the basal ganglia (Grahn & McAuley, 2009), a group of brain structures in the centre of the brain that are related to the coordination of movement. Additional studies have tried to figure out if the basal ganglia are involved with *discovering* a beat or *maintaining an internal representation* of a beat, an ability that would allow the individual to predict future beats once the rhythm has been discovered. In one study by Jessica Grahn of

Western University, brain activity was measured while participants first learned a beat (i.e., discovered a beat) and when participants were familiar with a beat (i.e., maintained an internal representation). Activity in the putamen, one part of the basal ganglia, was much higher when a familiar beat was repeatedly presented to the participants (Grahn & Rowe, 2013).

Importantly, the basal ganglia do not work alone. As with most of our behaviours, detecting musical beats involves a number of brain areas working together as a team. When we perceive beats, there is an increase in connectivity (brain areas firing together) between the basal ganglia and areas of the frontal lobe related to the planning of movements (Grahn & Rowe, 2009). In fact, one study showed that this coordinated brain activity increased as the beat became more noticeable (Chen et al., 2008); however, more research is needed before we draw any definitive conclusions.

Can we critically evaluate this information?

Although the evidence linking the basal ganglia to our ability to maintain a musical beat is compelling, we need to remember that brain imaging experiments show which areas of the brain are *active*; this does not guarantee that these regions are *necessary* for a function to occur. We therefore need evidence from other types of research studies to support this finding. Recently, researchers found that individuals with Parkinson's disease—who have damage to structures that input to the basal ganglia—have difficulty picking out subtle musical beats (Grahn, 2009).



The basal ganglia is a group of structures in the centre of your brain. Activity in this region is related to our ability to detect musical beats.

However, it is still possible that previous experience influenced these results to some degree. Almost everyone has heard musical beats; this previous knowledge might influence how we perceive new beats. Although this problem might seem impossible to solve, music researchers have found an interesting solution: play musical beats to animals. To do this, researchers measured the firing rates of brain cells in monkeys while they listened to repeated beats and random noise. Greater firing occurred in the putamen (basal ganglia) of monkeys when they heard a familiar beat (Barolo et al., 2014). Therefore, there is evidence from multiple types of research studies linking the perception of music to brain areas related to movement, specifically the basal ganglia.

Why is this relevant?

The link between musical beats and movement systems should make intuitive sense to most of you; it's almost impossible to listen to music without moving in some way. Musical beats allow people to synchronize movements with each other, leading to coordinated behaviours ranging from dancing to rocking a baby

to sleep. Interestingly, this ability is influenced by culture. Growing up in a given culture leads us to be more familiar with some musical rules and patterns than others; as a result, people from different cultures will have different rhythmic expectations and will therefore be more sensitive to certain musical rhythms (Levitin, 2006).

As you can see, the detection of musical beats influences many aspects of our lives. But discussing beats in terms of movement systems tells only part of the story. Think about the last time you danced; as you were moving, your body was adjusting its position so that you were (hopefully) able to avoid falling on your face. The body's ability to do so leads us to a discussion of another role played by the structures found within our ears: balance.

The Vestibular System

Listen to the Audio

On February 10, 2014, Canadian freestyle skier Alexandre Bilodeau stood at the top of the moguls course at the Rosa Khudor Extreme Park in Sochi, Russia. His Russian rival, Alexandr Smyshlyaev, had just amazed the crowd by performing a flip *while grabbing his skis* after going over one of the two jumps on the course. Bilodeau needed to put in an almost perfect run if he was to repeat as Olympic gold medallist. As he began the course, Bilodeau maintained his balance while carving perfect turns around the moguls. As his descent continued, he picked up more speed and hurtled toward the first jump, which had caused many of his competitors to fall. Undaunted, he leapt up, performed multiple twists in the air, and landed with his feet again in perfect moguls stance. He continued down the course and picked up even more speed before taunting gravity again with a dazzling display of twists and flips before racing down across the finish line. The gold was his. When we watch breathtaking feats of athleticism like Bilodeau's, it's easy to forget that these abilities rely on our perceptual abilities. In the case of freestyle skiing, the ability to maintain one's balance is related to the activity of two structures in the inner part of the ears.

The vestibular system in the inner ear provides information about the head’s movement and spatial orientation. It is crucial for our sense of balance. Sports such as gymnastics and freestyle skiing rely on this system.

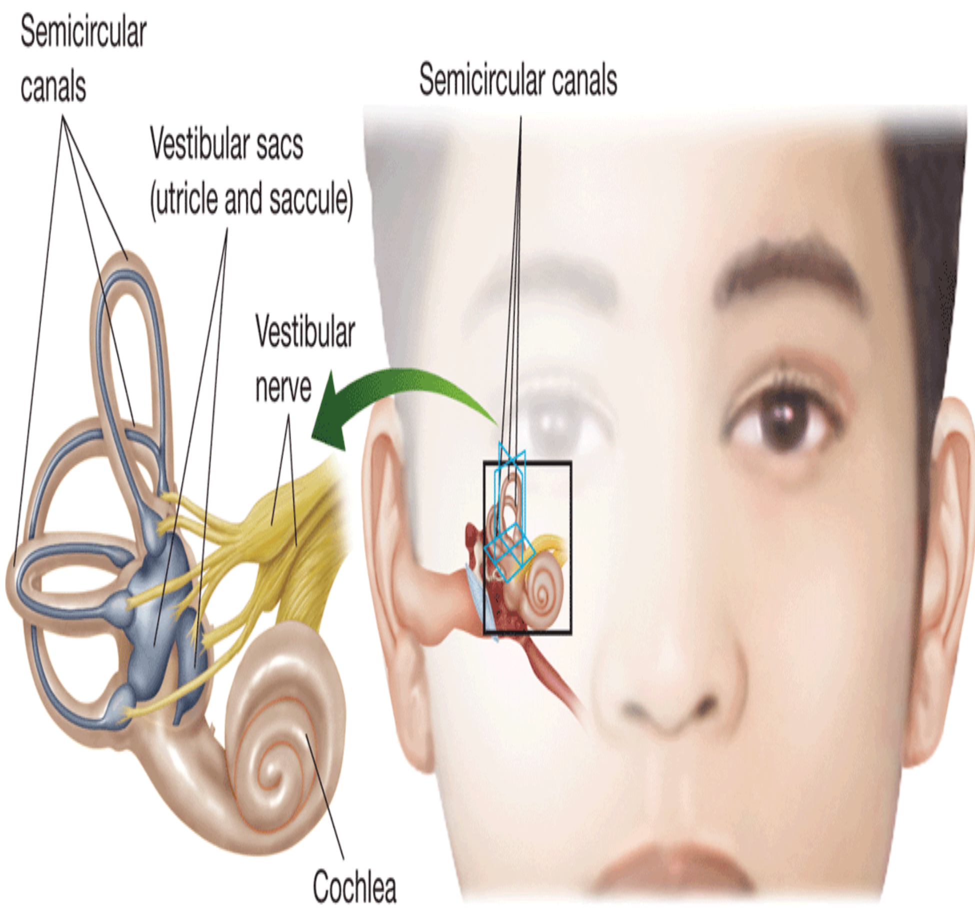
Brian Peterson/ZUMA Press Inc/Alamy Stock Photo

Sensation and the Vestibular System

Listen to the Audio

Our sense of balance is controlled, at least in part, by our **vestibular system**, *a sensory system in the ear that provides information about spatial orientation of the head as well as head motion*. This system consists of two groups of structures (see Figure 4.34). The **vestibular sacs** *are structures that influence your ability to detect when your head is no longer in an upright position*. This section of your vestibular system is made up of two parts: the *utricle* ("little pouch") and the *saccule* ("little sac"). The bottom of both of these sacs is lined with cilia (small hair cells) embedded in a gelatinous substance. When you tilt your head, the gelatin moves and causes the cilia to bend. This bending of the cilia opens up ion channels, leading to an action potential.

Figure 4.34 The Vestibular System



The vestibular system consists of two groups of structures. The vestibular sacs detect our head's position, particularly when it is no longer upright. The semicircular canals—shown in detail on the left—detect when our head is in motion. Both structures send information to nuclei in the brainstem.

Your ability to perceive when your head is in motion involves a separate group of vestibular structures. The **semicircular canals** are *three fluid-filled canals found in the inner ear that respond when your head moves in different directions (up-down, left-right, forward-backward)*. Receptors in each of these canals respond to movement along one of these planes. At the base of each of these canals is an enlarged area called the *ampulla*. The neural activity within the ampulla is similar to that of the vestibular sacs—cilia (hair cells) are embedded within a gelatinous mass. When you move your head in different directions, as Alexandre Bilodeau did during

his flips, the gelatin moves and causes the cilia to bend. This bending, again, makes an action potential more likely to occur.

Although it may seem as though the vestibular system would only fire when we moved our heads in different directions, the vestibular sacs and semicircular canals actually provide the brain with a continuous flow of information about the head's position and movement (Tascioglu, 2005). This constant input from the vestibular system allows us to keep our head upright and to maintain our balance. When you have an inner ear infection, this stream of input can be disrupted. The result is dizziness and a loss of balance.

The Vestibular System and the Brain

Listen to the Audio

Of course, for the activity of the vestibular sacs and semicircular canals to have an effect on our perceptual experiences, they need to transmit information from the inner ear to the brain. These two parts of the vestibular system send information along the vestibular ganglion, a large nerve fibre, to nuclei in the brainstem. Vestibular nuclei can then influence activity in a number of brain areas. For instance, the panic we feel when we lean too far back in a chair is likely due to the fact that vestibular nuclei in the brainstem influence the activity of your autonomic nervous system ("fight or flight") as well as the amygdala, an emotion centre of the brain (Petrovich & Swanson, 1997; Carmona et al., 2009). The vestibular nuclei also project to part of the insula, an area of cortex that is folded in the interior of the brain (de Waele et al., 2001; Guldin & Grusser, 1998). This region helps us link together visual, somatosensory, and vestibular information. At times, however, this process goes awry.

Have you ever experienced motion sickness, perhaps when trying to read while in moving vehicle? One reason for this feeling is an inconsistency in the input from your visual and vestibular systems. The visual input (i.e., the words on the page) is not moving, yet your vestibular system is sending signals to your brain saying that your body is in a moving car. The driver, on the other hand, sees (and controls) the movement of the car; he or she therefore has the same movement-related information arriving from both sensory systems.

This link between the vestibular system and other senses brings us back to the example of Alexandre Bilodeau, the freestyle skier discussed earlier in this section. In order to maintain balance, Bilodeau had to receive input from his vestibular sacs and semicircular canals. But he also needed to have information about kinesthesis, the sense of bodily motion and position (see Module 4.4). Together, this input allowed Bilodeau to maintain his balance while he performed his gravity-defying jumps and to continue skiing around the moguls when he landed. Without these inner ear structures and feedback from his body, Bilodeau's trip to the Sochi Olympics would certainly have been less golden.

Module 4.3 Summary

Listen to the Audio

4.3a Know . . . the key terminology relating to the ear and hearing.

Review Module 4.3

Start Over Swap

0/9 REVIEWED · 0 MASTERED

cochlea

Previous Next Got It!

4.3b Understand . . . different characteristics of sound and how they correspond to perception.

Sound can be analyzed based on its frequency (the number of cycles a sound wave travels per second) as well as on its amplitude (the height of

a sound wave). Our experience of pitch is based on sound wave frequencies. Amplitude corresponds to loudness: The higher the amplitude, the louder the sound.

4.3c Understand . . . how the vestibular system affects our sense of balance.

The vestibular system consists of two components: the vestibular sacs and the semicircular canals. The vestibular sacs note the position of the head relative to the body. The semicircular canals note when the head is in motion. Both structures send information to brain regions that integrate vestibular information with input from other senses; this process allows us to maintain our balance.

4.3d Apply . . . your knowledge of sound localization.

Apply Activity Your Knowledge of Sound Localization

Noise exposure, depending on the volume, duration, and frequency of occurrence, can lead to permanent hearing loss. To get a quick assessment of your noise exposure, complete the “1-minute noise screen” developed by Tiffany Johnson and colleagues.

Previous Next

Source: From Johnson, T.A., Cooper, S., Stamper, G.C., & Chertoff, M. (2017). Noise exposure questionnaire (NEQ): A tool for quantifying annual noise exposure. *Journal of the Academy of Audiology*, 28, 14-35.

4.3e Analyze . . . how musical beats are related to movement.

It seems intuitive that music and movement are related. However, testing this relationship involves critical thinking. Although brain imaging studies in healthy individuals have shown basal ganglia activity when people follow beats, we must remember that this activity does not mean that the basal ganglia are *necessary* for beat perception. However, studies of patients with damage to the basal ganglia, structures in the middle of the brain related to movement, show that these structures *are* likely necessary for us to be able to follow a musical beat. Together, these studies provide a scientific explanation for our ability to tap our fingers to the rhythm of our favourite songs.

Module 4.4 Touch and the Chemical Senses

Listen to the Audio

tuja66/Getty Images

Learning Objectives

4.4a Know . . . the key terminology of touch and chemical senses.

4.4b Understand . . . how pain messages travel to the brain.

4.4c Understand . . . the relationship between smell, taste, and food flavour experience.

4.4d Apply . . . your knowledge about touch to describe the acuity of different areas of skin.

4.4e Apply . . . your knowledge to determine whether you or someone you know is a "supertaster."

4.4f Analyze . . . how different senses are combined together.

Would you ever describe your breakfast cereal as tasting pointy or round? Probably not. Touch, taste, and smell combine together to make your favourite foods, yet most of us can still identify the separate components associated with what is felt, tasted, and smelled. Individuals with a condition called synesthesia experience blended perceptions, such that affected individuals might actually hear colours or feel sounds (Cytowic, 1993). For individuals who experience synesthesia, even letters or numbers may have a colour associated with them. To illustrate this effect, find the number 2 below:

5555555555555555555555

5555555555555555555555

5555555555555552555555

5555555555555555555555

People who have a type of synesthesia in which words or numbers have unique colours associated with them find the 2 faster than people without synesthesia because the colours cause the 2 to "pop out" (Blake

et al., 2005). In some individuals, even the idea of a number can elicit a colourful response (Dixon et al., 2000). Synesthesia can also involve blending taste and touch, which certainly can influence dining experiences. People may avoid oatmeal because it tastes bland, but can you imagine avoiding a food because it tastes "pointy," or relishing another food because of its delicate hints of corduroy? Synesthesia occurs in an estimated 1 in 500 people. For the 499 others, touch, taste, and smell are distinct senses.

Generally speaking, vision and hearing are the senses that we seem to be aware of the most and, therefore, have received the most attention from researchers. In this module, we will explore the senses of touch, taste, and smell. Putting them together in a single module is not meant to diminish their importance, however. Our quality of life, and possibly our survival, would be severely compromised without these senses. We will also examine how we combine information from our different senses into vibrant *multimodal* experiences, such as when taste and smell are combined to create a perception of flavour.

The Sense of Touch

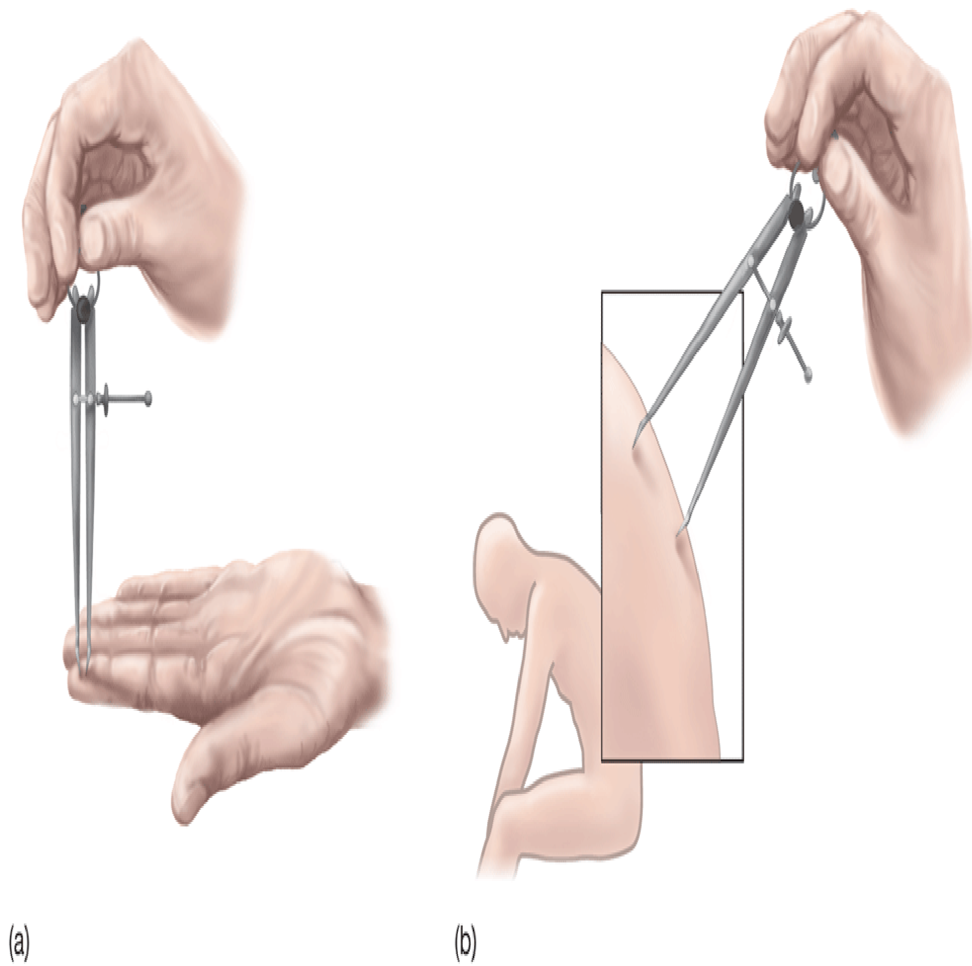
Listen to the Audio

The sense of touch allows us to actively investigate our environment and the objects that are in it (Lederman & Klatzky, 2004; Lederman et al., 2007). Using touch, we can acquire information about texture, temperature, and pressure upon the skin. These different forms of stimulation are combined to give us a vivid physical sense of every moment. Imagine you're at a concert. You don't just hear music. You *feel* the vibrations of the bass rippling through you. You *feel* the heat of the crowd. You *feel* other people brushing up against you. And you *feel* your own body moving to the rhythm of the music. These sensual experiences —which seem so social and so distant from the nervous system—are dependent on the actions of several types of receptors located just beneath the surface of the skin, and also in the muscles, joints, and tendons. These receptors send information to the *somatosensory cortex* in the parietal lobes of the brain, the neural region associated with your sense of touch.

Sensitivity to touch varies across different regions of the body. One simple method of testing sensitivity, or *acuity*, is to use the two-point threshold test shown in Figure 4.35. Regions with high acuity, such as the fingertips, can detect the two separate, but closely spaced, pressure points of the device, whereas less sensitive regions such as the lower back will perceive the same stimuli as only one pressure point. Body parts such as the fingertips, palms, and lips are highly sensitive to touch compared to regions such as the calves and forearm. Research has shown that

women have a slightly more refined sense of touch than men, precisely because their fingers (and therefore their receptors) are smaller (Peters et al., 2009). Importantly, the sensitivity of different parts of the body also influences how much space in the somatosensory cortex is dedicated to analyzing each body part's sensations (see Figure 3.26 in Module 3.3). Regions of the body that send a lot of sensory input to the brain such as the lips have taken over large portions of the somatosensory cortex while less sensitive regions like the thigh use much less neural space (see Figure 4.36).

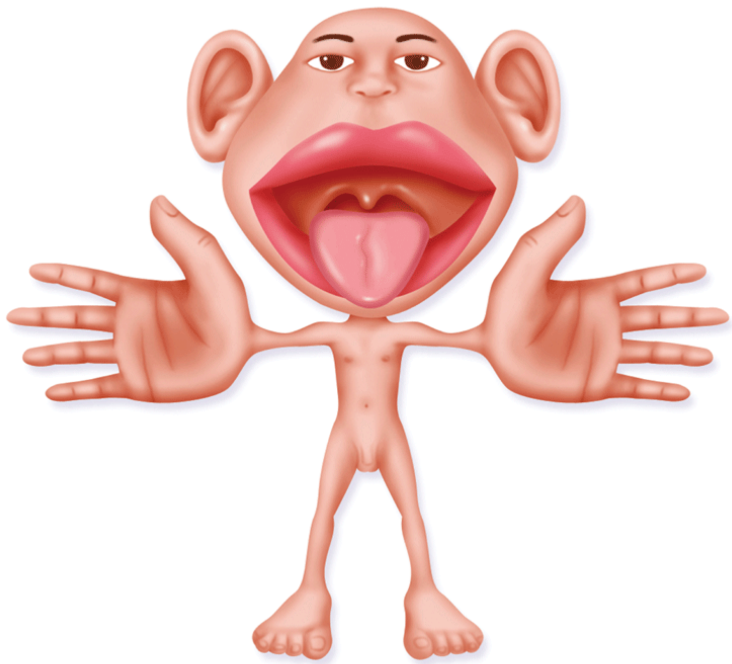
Figure 4.35 Two-Point Threshold Device for Measuring Touch Acuity



The more sensitive regions of the body can detect two points even when they are spaced very close together. Less sensitive parts of the body have

much larger two-point thresholds.

Figure 4.36 The Sensory Homunculus



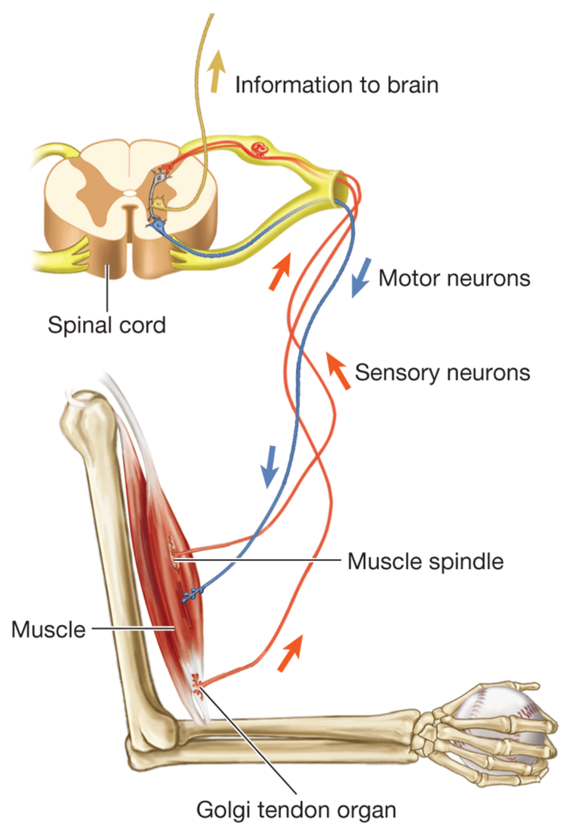
Sensitive areas of the body used to acquire somatosensory information use larger portions of the somatosensory cortex than less sensitive body parts. The amount of cortex used by each body part is represented in the homunculus (“little man”) depicted above.

BSIP SA/Alamy Stock Photo

Like vision and hearing, touch is very sensitive to change. Merely laying your hand on the surface of an object does little to help identify it. What we need is an active exploration that stimulates receptors in the hand. **Haptics** *is the active, exploratory aspect of touch sensation and perception*. Active touch involves feedback. For example, as you handle an object, such as a piece of fruit, you move your fingers over its surface to identify whether any faults may be present. Your fingertips can help you determine whether the object is the appropriate shape and can detect bruising or abnormalities that may make it unsuitable to eat. Haptics

allows us not only to identify objects, but also to avoid damaging or dropping them. Fingers and hands coordinate their movements using a complementary body sense called **kinesthesis**, *the sense of bodily motion and position*. Receptors for kinesthesis reside in the muscles, joints, and tendons. These receptors transmit information about movement and the position of your muscles, limbs, and joints to the brain (Figure 4.37). As you handle an object, your kinesthetic sense allows you to hold it with enough resistance to avoid dropping it, and to keep your hands and fingers set in such a way as to avoid letting it roll out of your hands. Touch, therefore, provides us with a great deal of information about our bodies and the world around us.

Figure 4.37 The Sense of Kinesthesis



Receptors in muscles and joints send sensory messages to the brain, helping us maintain awareness and control of our movements. Muscle

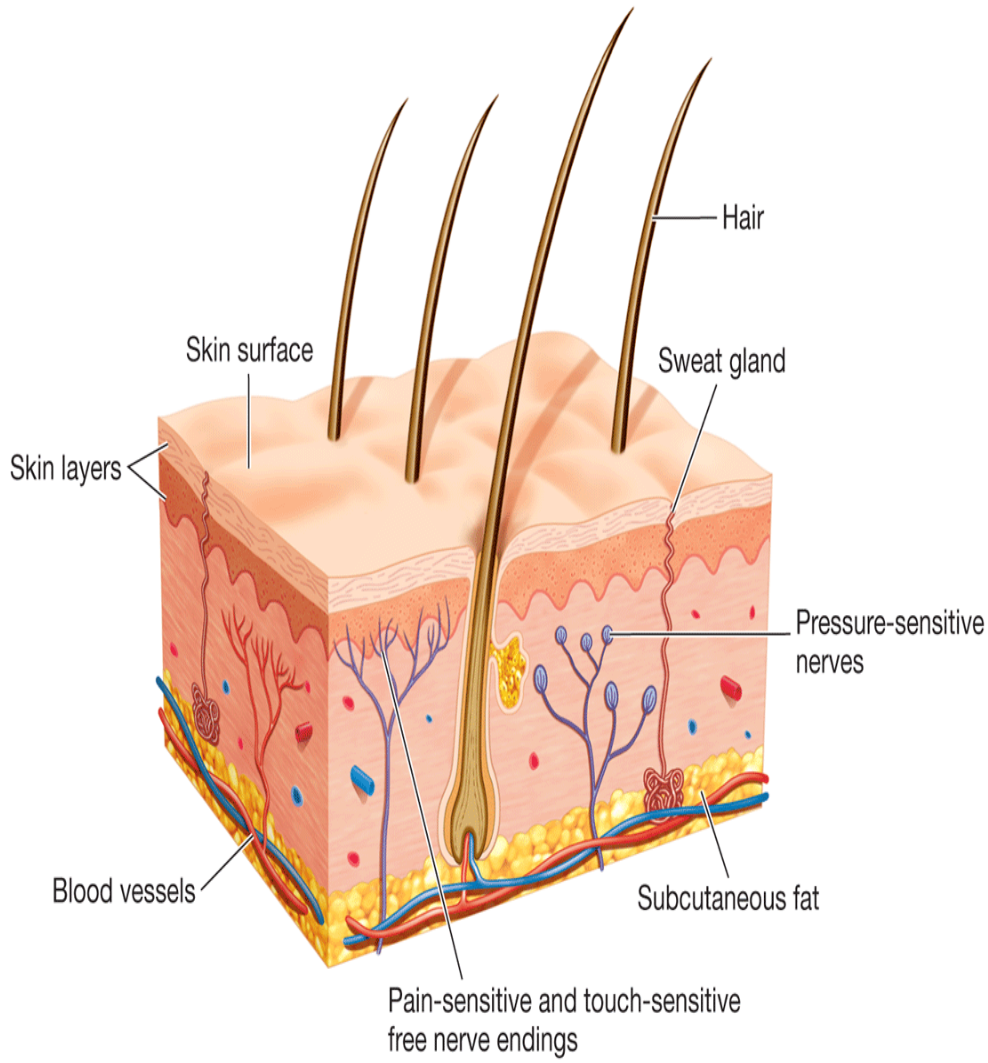
spindles and Golgi tendon organs are sensory receptors that provide information about changes in muscle length and tension.

Feeling Pain

Listen to the Audio

Of course, not all of the information we receive from our sense of touch is pleasant. **Nociception** *is the activity of nerve pathways that respond to uncomfortable stimulation*. Our skin, teeth, corneas, and internal organs contain nerve endings called *nociceptors*, which are receptors that initiate pain messages that travel to the central nervous system (see Figure 4.38). Nociceptors come in varieties that respond to various types of stimuli—for example, to sharp stimulation, such as a pin prick, or to extreme heat or cold (Julius & Basbaum, 2001).

Figure 4.38 Cross-Section of Skin and Free Nerve Endings That Respond to Pain



The nerve endings that respond to pain reside very close to the surface of the skin and, as you are likely aware, are very sensitive to stimulation.

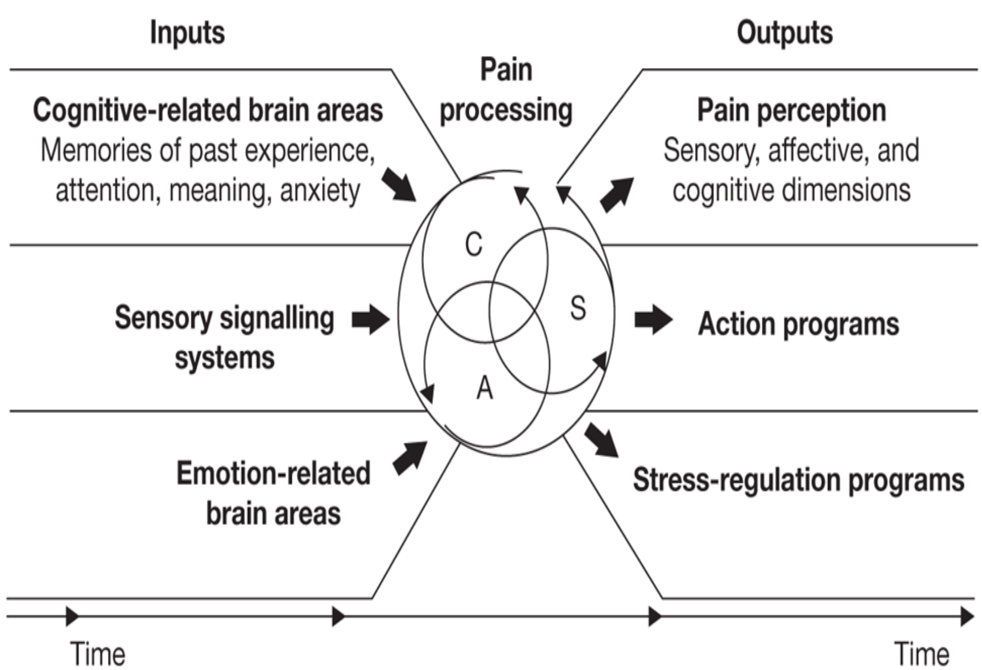
Two types of nerve fibres transmit pain messages. Fast fibres register sharp, immediate pain, such as the pain felt when your skin is scraped or cut. Slow fibres register chronic, dull pain, such as the lingering feelings of bumping your knee into the coffee table. Although both slow and fast fibres eventually send input to the brain, these impulses first must travel to cells in the spinal cord; the firing of neurons within the spinal cord will influence how this pain is experienced.

The activity of pathways in the spinal cord can explain several interesting characteristics of pain perception, including why you feel better if you rub your toe after stubbing it on your coffee table. One long-held theory of pain perception is the **gate-control theory**, *which explains our experience of pain as an interaction between nerves that transmit pain messages and those that inhibit these messages*. According to this theory, cells in the spinal cord regulate how much pain signalling reaches the brain. The spinal cord serves as a "neural gate" that pain messages must pass through (Melzack & Wall, 1965, 1982). The spinal cord contains small nerve fibres that conduct pain messages and larger nerve fibres that conduct other sensory signals such as those associated with rubbing, pinching, and tickling sensations. Stimulation of the small pain fibres results in the experience of pain, whereas the larger fibres inhibit pain signals so that other sensory information can be sent to the brain. Thus, the large fibres close the gate that is opened by the smaller fibres. According to gate-control theory, if you stub your toe, rubbing the area around the toe may alleviate some of the pain because the large fibres carrying the message about touch inhibit the firing of smaller fibres carrying pain signals. Likewise, putting ice on an injury reduces pain by overriding the signals transmitted by the small fibres.

The gate-control theory provided an important first step in our understanding of pain. Updates of this theory have allowed researchers to explain even more pain-related experiences (Melzack & Katz, 2013). Our experience of pain obviously involves input from the spinal cord to the somatosensory cortex—this provides our brain with information about the location of the aversive stimulation. However, pain is not just sensation gone awry. Expectations and memory can both increase (or decrease) your feelings of pain. Attention, too, can influence how painful a stimulus seems. If you focus all of your attention on the pain, it will feel worse than if you're focusing on something else. Pain is also related to emotions; negative emotions increase the perception of pain (Loggia et al., 2008b),

while positive emotions can provide a buffer against it (Pulvers & Hood, 2013). As shown in Figure 4.39, these cognitive, sensory, and emotional factors all interact to influence nociception. This interaction is why the same painful stimulus might rate as a 5/10 on a pain scale one day and as a 7/10 another day—cognitive and emotional factors likely differed between the two days.

Figure 4.39 Multiple Factors Influence Pain-Related Behaviours



Cognitive, sensory, and emotional (affective) factors all influence how we experience pain. Importantly, pain also leads to multiple behavioural responses, including stress. This likely explains why different people—including some patient populations—are particularly sensitive to painful stimuli.

Source: From Pain, *WIREs Cognitive Science*, Vol 4, Issue 1, by Ronald Melzack, Joel Katz.

This updated view of pain also helps explain why different people produce different pain-related responses. Our response to pain isn't simply, "Ouch!" It involves the feeling of pain, as well as some form of

movement and an emotional or stress-related response to being in pain. Many of these responses involve the anterior cingulate gyrus, a brain area above the corpus callosum that forms networks with many structures in the limbic system.

Our discussion thus far has focused on how we perceive pain when it affects our own body. But how do you feel when you see *someone else* in pain? And does the pain of other people affect how your own pain feels? Psychology researchers have begun to address these complicated—and fascinating—questions.

Working the Scientific Literacy Model

Empathy and Pain

Listen to the Audio

A running theme of this chapter has been that sensation and perception involve an interaction with your environment. While the term *environment* often makes people think of birds, trees, and buildings, a key part of our environment is other people. Is it possible for one person's somatosensory experiences to influence those of another person?

What do we know about empathy and pain?

We've all seen someone in pain. Sometimes it's a friend stubbing his toe on a chair; other times it's a person rubbing her foot after stepping on a piece of Lego. Our experience of these situations differs a great deal. If we see someone we care about in pain, we experience negative emotions and sometimes even feel pain ourselves. If it is a stranger or someone we don't like, our reaction might be less intense. This leads to several interesting questions. Are we able to feel the pain of others? Under what conditions? And how does the presence of another person influence how we experience pain? Perhaps pain and empathy, our capacity to share in other's experiences and emotions, are linked.

How does science explain the influence of empathy on pain perception?

The power of emotion in the experience of pain is profound. In one study, researchers at McGill University asked participants to immerse their right hand in hot water while viewing emotionally negative videos (disaster scenes) and neutral videos (cityscape scenes). Participants rated the unpleasantness of the pain as being higher when they watched disaster scenes (Loggia et al., 2008a). These results suggest that the emotional component of pain can influence our physical sensations, particularly when it involves seeing the suffering of others.

In another study, these researchers asked participants to feel either high or low levels of empathy for an actor in a video. The researchers then measured the participants' sensitivity to painful heat stimuli while they watched the actor experience similar stimulation. Participants who felt empathy for the actor reported experiencing higher levels of pain than did low-empathy participants. This result suggests that emotionally connecting with someone else in pain can influence our own sensitivity (Loggia et al., 2008b).

Can we critically evaluate the research?

An obvious criticism of research studies involving emotion and the experience of pain is that the participants may simply be reporting what they think the experimenters want to hear. If you were in a study in which someone was manipulating your mood, you would likely be able to predict the hypotheses being tested in that study. It is therefore necessary to find additional support for these self-report experiments. Numerous neuroimaging studies have found that activity in a brain structure called the insula (near the junction of the frontal lobes and the top of the temporal lobes) is related to the awareness of bodily sensations (Wiens, 2005). Activity in the insula also increases when people are performing empathy-related tasks (Fukushima et al., 2011). Thus,

there might be a biological link between feeling pain and feeling empathy (Zaki et al., 2016).

Stronger support comes from studies that show an effect of empathy on pain perception in individuals that are much less likely to be influenced by the experimenter's expectations: mice! When injected with a pain-inducing substance, mice that were tested in pairs showed more pain-related behaviours than did mice that were tested alone. But this effect only occurred when the mice were cagemates with their test partner (i.e., they knew the other mouse)! Additionally, observing a cagemate in pain altered the mouse's own pain sensitivity, suggesting that these animals are capable of some form of empathy (Langford et al., 2006). Even more remarkable, some male mice failed to show pain responses in the presence of mice they didn't know (a mouse version of acting tough); this effect, not surprisingly, appears to be dependent upon the hormone testosterone (Langford et al., 2011; see Module 3.2). Taken together, these neuroimaging and animal-based studies suggest that our own pain can be dramatically influenced by the pain of those around us.

Why is this relevant?

These studies demonstrate that our sensations, particularly pain, can be influenced by the experiences of other people. Feeling negative emotions or seeing someone else feel pain makes our own pain more unpleasant. Although these studies might seem a bit morbid, they do offer an incredibly important insight that could affect the well-being of many people. If people can influence each other's negative sensations, then it should be possible to influence each other's positive sensations. Just as pain can be "contagious," so too might happiness and well-being.

Phantom Limb Pain

Listen to the Audio

Astonishingly, it is possible for people to feel pain in body parts that no longer exist. **Phantom limb sensations** *are frequently experienced by amputees, who report pain and other sensations coming from the absent limb*. Amputees describe such sensations as itching, muscle contractions, and, most unfortunately, pain. One explanation for phantom pain suggests that rewiring occurs in the brain following the loss of the limb. After limb amputation, the area of the somatosensory cortex formerly associated with that body part is no longer stimulated by the lost limb. Thus, if someone has their left arm amputated, the right somatosensory cortex that registers sensations from the left arm no longer has any input from this limb. Healthy nerve cells become hypersensitive when they lose connections. The phantom sensations, including pain, may occur because the nerve cells in the cortex continue to be active, despite the absence of any input from the body.

One ingenious treatment for phantom pain involves the mirror box (Figure 4.40). This apparatus uses the reflection of the amputee's existing limb, such as an arm and hand, to create the visual appearance of having both limbs. Amputees often find that watching themselves move and stretch the phantom hand, which is actually the mirror image of the real hand, results in a significant decrease in phantom pain and in both physical and emotional discomfort (Ramachandran & Altschuler, 2009).

Figure 4.40 A Mirror Box Used in Therapy for People with Limb Amputation

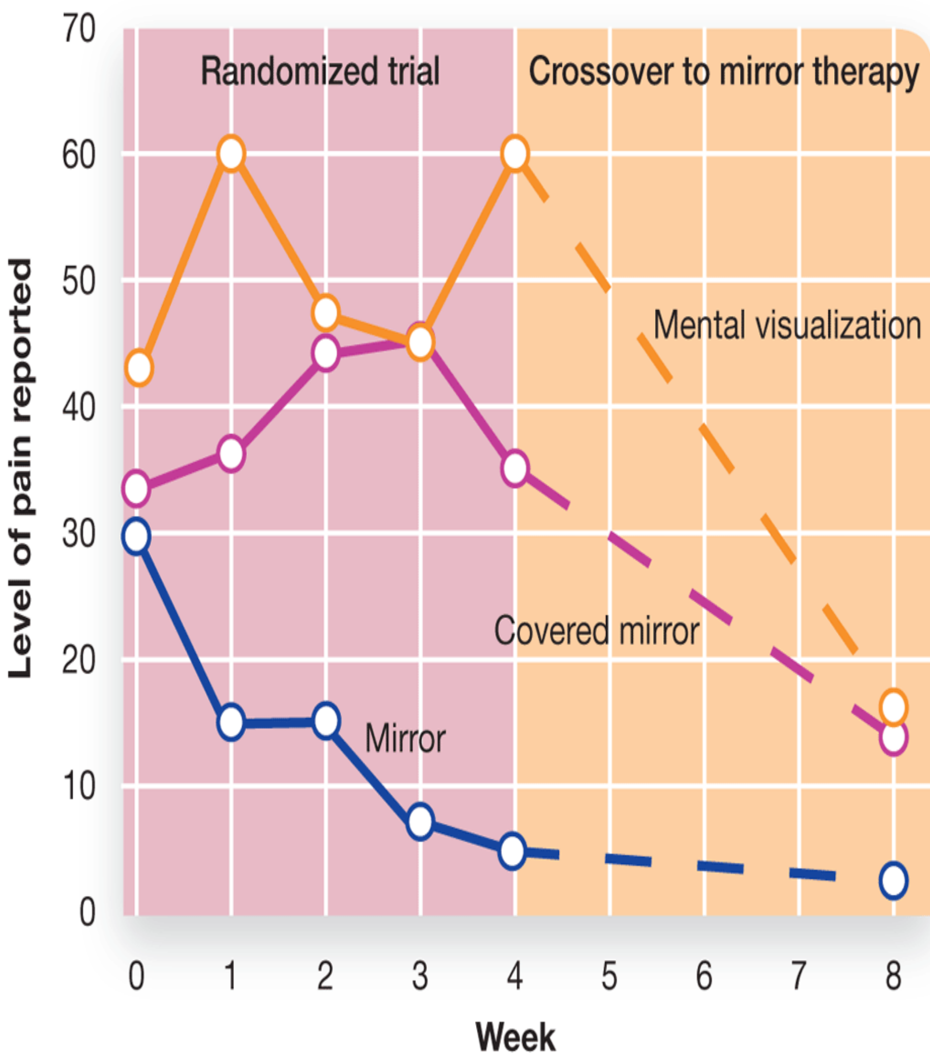
In this case, a woman who has lost her left arm can experience some relief from phantom pain by moving her intact hand, such as by unclenching her fist. In turn, she will experience relief from phantom pain corresponding to her left side.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed. ©2011, p.157. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Researchers have conducted experiments to determine how well mirror box therapy works compared both to a control condition and to mentally visualizing the presence of a phantom hand. Over the course of four weeks of regular testing, the people who used the mirror box had significantly reduced pain compared to a control group who used the same mirror apparatus, except the mirror was covered; they also had less pain than a group who used mental visualization (Figure 4.41; Chan et al., 2007). Notice in Figure 4.40 that everyone was given mirror therapy after the fourth week of the study, and that the procedure seemed to have lasting, positive benefits. No one is sure why mirror box therapy works,

but evidence suggests that the short-term benefits are due to how compelling the illusion is; in the long term, this therapy may actually result in reorganization of the somatosensory cortex (Ramachandran & Altschuler, 2009).

Figure 4.41 Mirror Box Therapy Compared to Mental Visualization and a Control Condition



Source: Chan, B. L., et. al., (2006). Mirror Therapy for Phantom Limb Pain, *The New England Journal of Medicine*, *357*(21), 2206, Massachusetts Medical Society, 2007.

The Chemical Senses: Taste and Smell

Listen to the Audio

The chemical senses comprise a combination of both taste and smell. Although they are distinct sensory systems, both begin the sensory process with chemicals activating receptors on the tongue and mouth, as well as in the nose.

The Gustatory System: Taste

Listen to the Audio

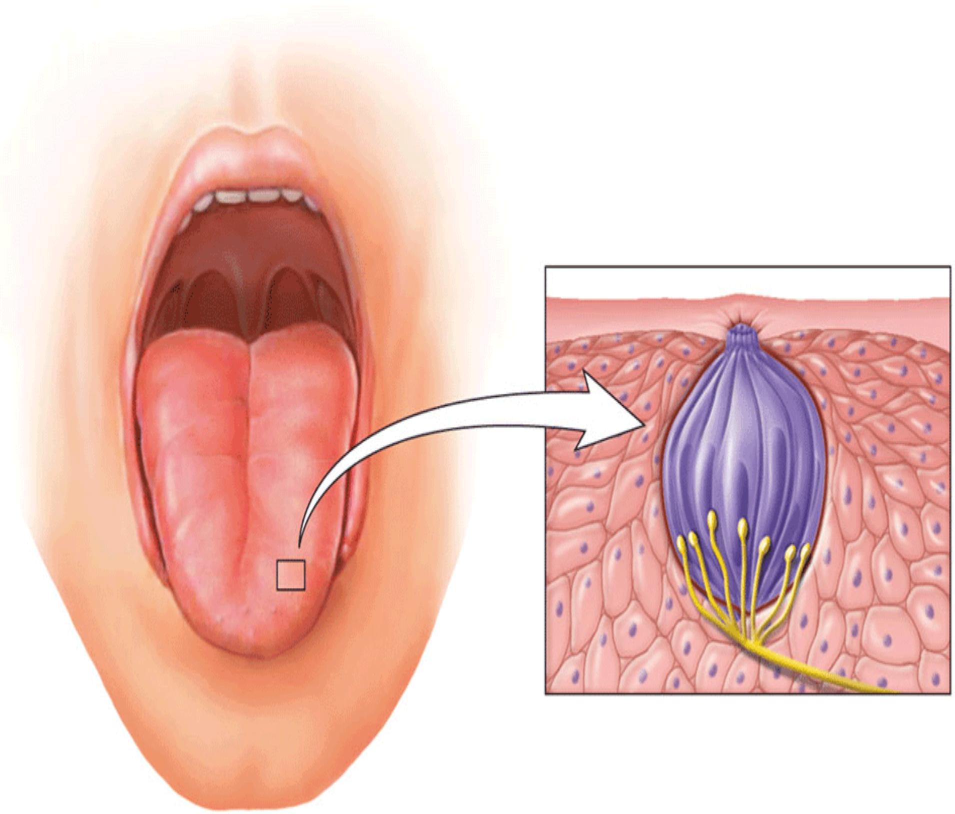
The **gustatory system** *functions in the sensation and perception of taste*. But what exactly is this system tasting? Approximately 2500 identifiable chemical compounds are found in the food we eat (Taylor & Hort, 2004). When combined, these compounds give us an enormous diversity of taste sensations. The *primary tastes* include salty, sweet, bitter, and sour. In addition, a fifth taste, called *umami*, has been identified (Chaudhari et al., 2000). Umami, sometimes referred to as "savouriness," is a Japanese word that refers to tastes associated with seaweed, the seasoning monosodium glutamate (MSG), and protein-rich foods such as milk and aged cheese.

Taste is registered primarily on the tongue, where roughly 9000 taste buds reside. On average, approximately 1000 taste buds are also found throughout the sides and roof of the mouth (Miller & Reedy, 1990). Sensory neurons that transmit signals from the taste buds respond to different types of stimuli, but most tend to respond best to a particular taste. Our experience of taste reflects an overall pattern of activity across many neurons, and generally comes from stimulation of the entire tongue rather than just specific, localized regions. The middle of the tongue has very few taste receptors, giving it a similar character to the blind spot on the retina (Module 4.2). We do not feel or sense the blind spot of the tongue because the sensory information is filled in, just as we find with vision. Taste receptors replenish themselves every 10 days throughout the lifespan—the only type of sensory receptor to do so.

Watch The Tongue and Tastebuds

Receptors for taste are located in the visible, small bumps (*papillae*) that are distributed over the surface of the tongue. The papillae are lined with taste buds. Figure 4.42 shows papillae, taste buds, and an enlarged view of an individual taste bud and a sensory neuron's dendrites and axon that sends a message to the brain. The bundles of nerves that register taste at the taste buds send the signal through the thalamus and on to higher-level regions of the brain, including the *gustatory cortex*; this region is located in the back of the frontal lobes and extends inward to the insula (near the top of the temporal lobe). Another region, the *secondary gustatory cortex*, processes the pleasurable experiences associated with food.

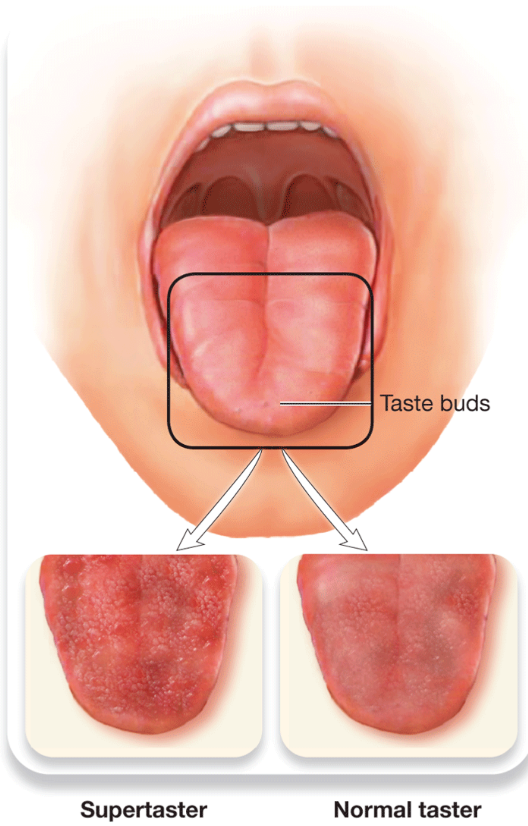
Figure 4.42 Papillae and Taste Buds



The tongue is lined with papillae (the bumpy surfaces). Within these papillae are your taste buds, the tiny receptors to which chemicals bind.

Why do some people experience tastes vividly while other people do not? One reason is that the number of taste buds present on the tongue influences the psychological experience of taste. Although approximately 9000 taste buds is the average number found on the human tongue, there is wide variation among individuals. Some people may have many times this number. *Supertasters*, who account for approximately 25% of the population, are especially sensitive to bitter tastes such as those of broccoli and black coffee. They typically have lower rates of obesity and cardiovascular disease, possibly because they tend not to prefer fatty and sweet foods. Figure 4.43 shows the number of papillae, and hence taste buds, possessed by a supertaster compared to those without this ability.

Figure 4.43 Density of Papillae in a Supertaster and in a Normal Taster



Some of the individual differences in taste sensitivity may be due to the number of taste buds found on the tongue. Supertasters (left tongue) have many more taste buds than the average person (right tongue).

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, Books A La Carte Edition, 2nd ed. © 2011. Reprinted and Electronically reproduced by permission of Pearson Education, Inc., New York, NY.

How much of our taste preferences are learned and how much are innate? Like most of our behaviours, there is no simple answer. Human infants tend to prefer the foods consumed by their mothers during gestation (Beauchamp & Mennella, 2009). Soon after starting solid foods, children begin to acquire a taste for the foods prevalent in their culture. Would you eat a piece of bread smeared with a sticky brown paste that was processed from wasted yeast from a brewery? This product, called vegemite, is actually quite popular among people in Switzerland,

Australia, and New Zealand. People brought up eating vegemite may love it, while most others find it tastes like death. The Masai people of Kenya and Tanzania enjoy eating a coagulated mixture of cow's blood and milk. These foods may sound unappetizing to you. Of course, non-Canadians are often repulsed by poutine, a decadent mixture of french fries, cheese curds, and gravy, so we should be careful not to judge . . . too much.

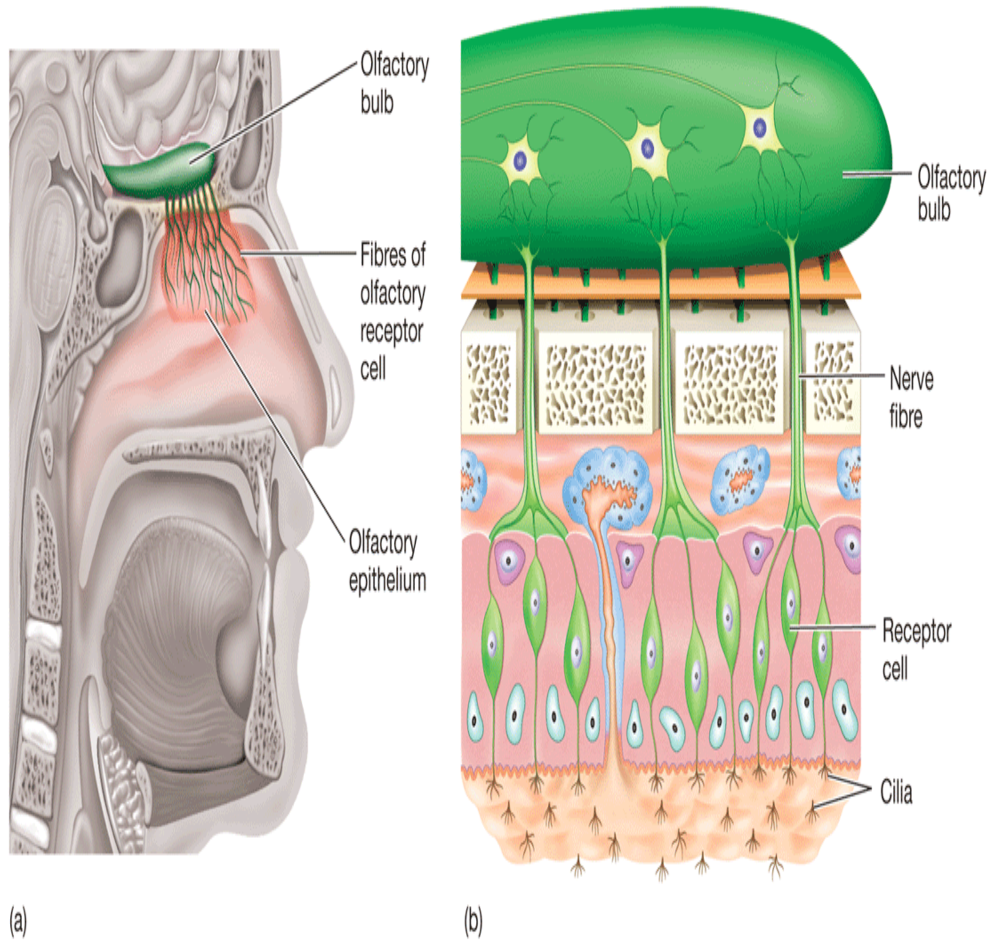
Closely related to taste is our sense of smell, which senses the chemical environment via a different mode than does taste.

The Olfactory System: Smell

Listen to the Audio

The **olfactory system** *is involved in smell—the detection of airborne particles with specialized receptors located in the nose*. Our sensation of smell begins with nasal air flow bringing in molecules that bind with receptors at the top of the nasal cavity. (So, when you smell something, you are actually taking in part of the environment—including other people—into your body.) Within the nasal cavity is the **olfactory epithelium**, *a thin layer of cells that are lined by sensory receptors called cilia*—tiny hair-like projections that contain specialized proteins that bind with the airborne molecules that enter the *nasal cavity* (Figure 4.44). Humans have roughly 1000 different types of odour receptors in their olfactory system, but can identify approximately 10 000 different smells. How is this possible? The answer is that different combinations of cilia are stimulated in response to different odours. It is the *pattern* of the stimulation, involving more than one receptor, which gives rise to the experience of a particular smell (Buck & Axel, 1991).

Figure 4.44 The Olfactory System



Lining the olfactory epithelium are tiny cilia that collect airborne chemicals, sending sensory messages to the nerve fibres that make up the olfactory bulb.

These groups of cilia then transmit messages directly to neurons that converge on the **olfactory bulb** on the bottom surface of the frontal lobes, *which serves as the brain's central region for processing smells*. (Unlike our other senses, olfaction does not involve the thalamus.) The olfactory bulb connects with several regions of the brain through the olfactory tract, including the limbic system (emotion) as well as regions of the cortex where the subjective experience of pleasure (or disgust) occurs.

Multimodal Integration

Listen to the Audio

Modules 4.2–4.4 have described our five different, most commonly discussed, sensory systems. After reading about them, it is quite tempting to view the five systems as being distinct from one another. After all, our brains are set up in such a way that it is simple to separate the different senses. Indeed, the doctrine of specific energies stated *in 1826* that our senses are separated in the brain (see Module 4.1). However, this view is at odds with some of our sensory experiences. Many of these experiences are actually combinations of multiple types of sensations, just as they are in individuals with synesthesia, the condition discussed at the beginning of this module. For example, the perceptual experience of flavour combines taste and smell (Small et al., 1997). You have probably noticed that when you have nasal congestion, your experience of flavour is diminished. You may also have noticed a child plugging their nose before eating or drinking something that to them tastes bad. This loss of taste occurs because approximately 80% of our information about food comes from olfaction (Murphy et al., 1977). This link between taste and smell is a perfect example of **multimodal integration**, *the ability to combine sensation from different modalities such as vision and hearing into a single integrated perception*.

What *Is* Multimodal Integration?

Listen to the Audio

Multimodal integration is so much more than simply combining different senses. In fact, it's a form of problem solving performed by your brain hundreds of times each day. We must decide, almost instantaneously, if two types of sensation should be integrated into a multimodal perception. How do we do this? One factor is whether the different sensations are in a similar location. If you hear a "meow" and see a cat with its mouth open, you infer that the movements of the cat's mouth and the "meow" sound were linked together. We also make use of temporal information. Sensations that occur in roughly the same time period are more likely to be linked than those that are not. If you hear a "meow" five seconds before the cat's mouth moved, you will not likely combine the sound with the sight of the cat (unless you know your cat is a ventriloquist).

Multimodal integration occurs quite naturally—we're often unaware of these perceptions until some outside force interferes with it. You may have experienced watching a television show or YouTube clip in which the movement of the characters' lips didn't match up with the sound of their voices. These perceptions are often annoying because the lag between the image and the sound makes it difficult to combine the two into the expected multimodal perception. In fact, sometimes this mismatch can interfere with perception, even to the point of producing new perceptions that did not actually occur.

This result occurred by accident in a study conducted by Harry McGurk and John MacDonald in 1976. These researchers were investigating language perception in infants and had videos of different actors producing sounds such as/ba-ba/. However, when the sound/ba-ba/was presented during the video of someone mouthing the sound/ga-ga/, the experimenters noticed that it seemed to produce an entirely different multimodal stimulus:/da-da/. It was as though the movement of the speaker's lips provided the viewer with the expectation of a particular sound; this expectation biased the perception of the presented sounds. This phenomenon is now known as the *McGurk Effect*.

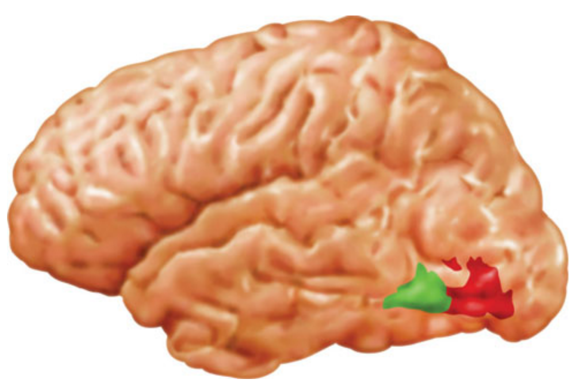
Expectations and multimodal integration can also influence our social interactions. We routinely integrate visual and auditory information when we are speaking with someone. Researchers have found that both women and men rated masculine faces (i.e., tough, rugged faces) as being more attractive when they were matched with a masculine voice (Feinberg et al., 2008). Other studies have shown that heterosexual men preferred viewing female faces that were paired with high-pitched rather than low-pitched voices (Feinberg et al., 2005). Facial expressions of a singer also influence judgments of the emotional content of songs (Thompson et al., 2008). These studies show us that we naturally form auditory expectations when we visually perceive a face.

Synesthesia

Listen to the Audio

If our brains are set up to perceive our senses separately and then combine them only when it seems appropriate (due to location, time, and expectations), how can we explain synesthesia, the condition discussed in the opening of this module? These blended multimodal associations (e.g., chicken that tastes "pointy") do not come and go. Rather, they occur automatically and are consistent over time (Ramachandran & Hubbard, 2003). Why does synesthesia occur?

This question has puzzled scientists since the first reported case of synesthesia in 1812 (Sachs, 1812; Jewanski et al., 2009). To date, there is still no clear answer. Researchers have noted that synesthesia does run in families (Baron-Cohen et al., 1996). However, the exact genes involved with this condition are still unknown. In fact, researchers at the University of Waterloo found a pair of identical twins, only one of whom had synesthesia (Smilek et al., 2001)!



Synesthetes who experience colours when they see letters or numbers have stronger connections between brain areas related to colour (red)

and letters/numbers (green).

Source: Figure 4 from Ramachandran, V. S., and Hubbard, E. M. (2001). "Synaesthesia—A window into perception, thought and language." *JCS, 8*(12), 3–34.

Neuroimaging studies have provided some insight into this condition. For instance, one research group tested synesthetes who have specific colour perceptions appear whenever they read a number (e.g., every time they see "2", it appears with a yellow border). These researchers found activity in areas of the brain related to colour perception in synesthetes, but not in non-synesthetes (Nunn et al., 2002). More recent studies suggest that the brains of people with synesthesia may contain networks that link different sensory areas in ways not found in other people (Dovern et al., 2012).

Together, these findings demonstrate a point made repeatedly in this text: Our experiences involve groups of brain areas working together. This point holds for all five of our senses, as well as for their multimodal integration.

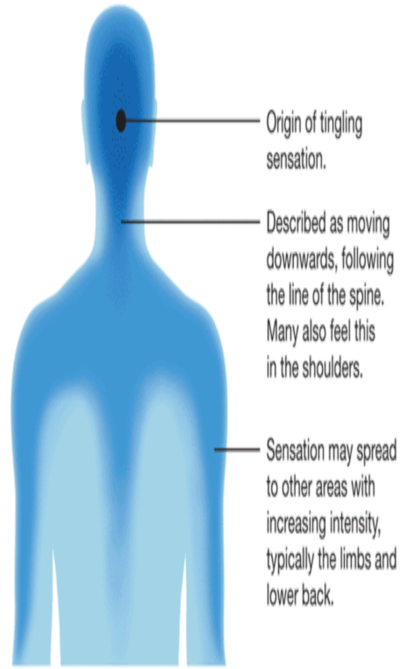
#Psych

Autonomous Sensory Meridian Response: When the Internet Gives you Tingles

Most of the neurological conditions and perceptual phenomena that you'll read about in this text were discovered in laboratories or hospitals. However, there is one perceptual phenomenon that was "discovered" in the comments sections of video-sharing websites such as YouTube. In 2010, a number of people reported experiencing tingling sensations on their scalp and neck in response to videos that contained

whispering. This handful of internet users quickly grew into a large internet community. Some of these individuals began to create videos specifically to elicit the tingling sensations. These videos were of people whispering softly, running their fingers gently across tissue paper, or making repetitive noises. The internet community who experience these tingles—not researchers or physicians—named their experience the **autonomous sensory meridian response (ASMR)**, *a phenomenon in which specific auditory or visual stimuli trigger tingling sensations in the scalp and neck, sometimes extending across the back and shoulders* (see Figure 4.45). What makes this condition so unusual is that many of the stimuli that trigger ASMR are social in nature, such as whispering or watching someone slowly brush their hair (Barratt & Davis, 2015). Those who experience ASMR may report that they find it relaxing or sleep-inducing. If you do not experience ASMR, you have likely experienced something similar called musical frisson, which are the spine-tingling chills elicited during a musical crescendo. The tingling induced by ASMR elicits activity in some of the same brain regions that are activated during musical frission (Lochte et al., 2018). Also, it appears that, like synesthesia, ASMR is caused by unusual, multimodal connections between different brain areas (Smith et al., 2016).

Figure 4.45 Autonomous Sensory Meridian Response (ASMR)



Individuals with ASMR experience tingling sensations on the scalp, shoulders, and back when they hear specific auditory and visual stimuli such as someone whispering or performing socially intimate acts such as braiding someone's hair.

Dmytro Zinkevych/123RF
Source (right): Barratt, E. L., & Davis, N. J. (2014). Autonomous sensory meridian response (ASMR): A flow-like mental state. *PeerJ PrePrints* 2:e719v1 https://doi.org/10.7287/peerj.preprints.719v1.

Module 4.4 Summary

Listen to the Audio

4.4a Know . . . the key terminology of touch and chemical senses.

Review Module 4.4

Start Over Swap

0/11 REVIEWED · 0 MASTERED

autonomous sensory meridian response

Previous Next Got It!

4.4b Understand . . . how pain messages travel to the brain.

According to gate-control theory, small nerve fibres carry pain messages from their source to the spinal cord, and then up to, among other regions, the anterior cingulate gyrus and somatosensory cortex. However, large

nerve cells that register other types of touch sensations (such as rubbing) can override signals sent by small pain fibres.

4.4c Understand . . . the relationship between smell, taste, and food flavour experience.

Both senses combine to give us flavour experiences. Contact with food activates patterns of neural activity among nerve cells connected to the taste buds, and food odours activate patterns of nerve activity in the olfactory epithelium. The primary and secondary gustatory cortex and the olfactory bulb are involved in the perceptual experience of flavour.

4.4d Apply . . . your knowledge about touch to describe the acuity of different areas of skin.

Apply Activity

Try creating a two-point threshold device like the one shown in Figure 4.35 by straightening a paper clip and then bending it so the two points are about 5 mm apart. Gently apply them to different parts of the body—your fingertips, elbow, cheek, and so on. Which parts of your body are sensitive enough to feel both points, and on which parts does it feel like a single object is touching you? Now try the experiment again with the two points closer together. Can you detect a change in acuity?

4.4e Apply . . . your knowledge to determine whether you or someone you know is a "supertaster."

Scientists use a very precise measurement system to identify supertasters, but one less complicated way to do so is to dye your tongue by placing a drop of food colouring on it, or by eating or drinking something dark blue or purple. Next, count the number of papillae you can see in a 4 mm circle. You can accomplish this by viewing the dyed portion of your

tongue through the punched hole in a sheet of loose-leaf notebook paper. If you can count more than 30 papillae, then chances are you are a supertaster. Of course, if you already know that you do not like bitter vegetables like broccoli or asparagus, then perhaps you would expect to find a high number of papillae.

4.4f Analyze . . . how different senses are combined together.

Humans have five distinct types of senses. However, that does not mean that these senses always operate independently—they often interact to form more vivid experiences. The flavour of food is an experience that involves both taste *and* smell. Numerous other studies have shown that our visual perception interacts with our auditory system, leading us to be surprised when sounds (such as the pitch of someone's voice) don't match our visual expectations.

Chapter 5
Consciousness

Listen to the Audio

5.1 Biological Rhythms of Consciousness: Wakefulness and Sleep

- What Is Sleep?
- Why Do We Need Sleep?
- Theories of Dreaming
- Disorders and Problems with Sleep
- Working the Scientific Literacy Model: Dreams, REM Sleep, and Learning
- Module 5.1 Summary

5.2 Altered States of Consciousness: Hypnosis, Mind-Wandering, and Disorders of Consciousness

- Hypnosis
- Mind-Wandering
- Disorders of Consciousness
- Working the Scientific Literacy Model: Assessing Consciousness in the Vegetative State
- Module 5.2 Summary

5.3 Drugs and Conscious Experience

Physical and Psychological Effects of Drugs

Commonly Abused Illegal Drugs

Legal Drugs and Their Effects on Consciousness

Working the Scientific Literacy Model: Marijuana, Memory, and Cognition

Module 5.3 Summary

Module 5.1 Biological Rhythms of Consciousness: Wakefulness and Sleep

Listen to the Audio

Mario Breda/Shutterstock

Learning Objectives

5.1a Know . . . the key terminology associated with sleep, dreams, and sleep disorders.

5.1b Understand . . . how the sleep cycle works.

5.1c Understand . . . theories of why we sleep.

5.1d Apply . . . your knowledge to identify and practise good sleep habits.

5.1e Analyze . . . different theories about why we dream.

> *Franz Kafka (1883–1924) was one of the strangest—and most influential—writers of the 20th century. His most famous work was a surreal novella,* The Metamorphosis*, in which a travelling salesman awakens one morning to discover that his body has transformed into a giant insect. He initially assumes that he needs to go back to sleep in order to feel human again; however, sleep evades him. Instead, the reader experiences the salesman's struggles as he adjusts to his new body, and to his new life as an insect. Although Kafka's work is obviously the product of a vivid imagination, researchers have recently suggested that it might also have been affected by Kafka's struggles with sleep (Perciaccante & Coralli, 2016). Kafka suffered from severe insomnia, a difficulty falling asleep, and often ended up writing throughout the night. In his letters, he even referred to night as "my old enemy." In fact, Kafka himself noted that being deprived of sleep allowed him access to strange thoughts and images that were not otherwise accessible to him, but that sleep deprivation affected his physical and mental health. In this module, we explore how normal sleep works. We will also explain how sleep deprivation and sleep disorders like Kafka's can affect how we act, think, and feel.*

Consciousness *is a person's subjective awareness, including thoughts, perceptions, experiences of the world, and self-awareness*. Every day we go

through many changes in consciousness—our thoughts and perceptions are constantly adapting to new situations. In some cases, when we are paying close attention to something, we seem to be more in control of conscious experiences. In other situations, such as when we are daydreaming, consciousness seems to wander. These changes in our subjective experiences, and the difficulty in defining them, make consciousness one of the most challenging areas of psychological study. We will begin this module by exploring the alternating cycles of consciousness—sleeping and waking.

What Is Sleep?

Listen to the Audio

It makes perfect sense to devote a module to a behaviour that humans spend approximately one-third of their lives doing. What happens during sleep can be just as fascinating as what happens during wakefulness. Psychologists and non-psychologists alike have long pondered some basic questions about sleep, such as “Why do we need sleep?” and “Why do we dream?” But perhaps we should begin with more basic questions, such as “What *is* sleep?” and “How does sleep relate to other biological rhythms?”

Biological Rhythms

Listen to the Audio

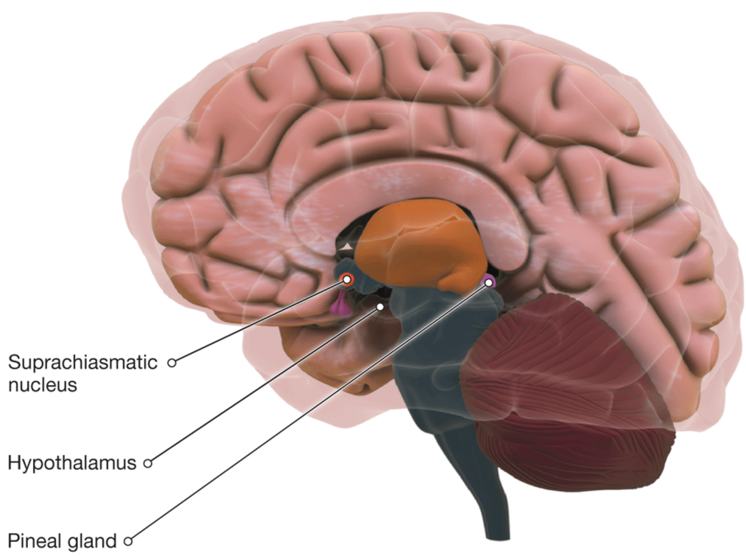
Life involves patterns—patterns that cycle within days, weeks, months, or years. Organisms have evolved *biological rhythms* that are neatly adapted to the cycles in their environment. For example, bears are well known for hibernating during the cold winter months. Because this behaviour happens on a yearly basis, it is part of a *circannual rhythm* (a term that literally means "a yearly cycle"). This type of rhythm is an example of an *infradian rhythm*, which is any rhythm that occurs over a period of time longer than a day. In humans, the best-known infradian rhythm is the menstrual cycle. However, most biological rhythms occur with a much greater frequency than once a month. For instance, heart rate, urination, and some hormonal activity occur in 90- to 120-minute cycles. These more frequent biological rhythms are referred to as *ultradian rhythms*.

However, the biological rhythm that appears to have the most obvious impact upon our lives is a cycle that occurs over the course of a day. **Circadian rhythms** *are internally driven daily cycles of approximately 24 hours affecting physiological and behavioural processes* (Halberg et al., 1959). They involve the tendency to be asleep or awake at specific times, to feel hungrier during some parts of the day, and even the ability to concentrate better at certain times than at others (Lavie, 2001; Verwey & Amir, 2009).

Think about your own circadian rhythms: When are you most alert? At which times of day do you feel the most tired? Night shift workers and night owls aside, we tend to get most of our sleep when it is dark outside

because our circadian rhythms are regulated by daylight interacting with our nervous and endocrine (hormonal) systems. One key brain structure in this process is the *suprachiasmatic nucleus* (SCN) of the hypothalamus. Cells in the retina of the eye relay messages about light levels in the environment to the SCN (Hendrickson et al., 1972; Morin, 2013). The SCN, in turn, communicates signals about light levels with the pineal gland (see Figure 5.1). The pineal gland releases a hormone called *melatonin*, which peaks in concentration at nighttime and is reduced during wakefulness. Information about melatonin levels feeds back to the hypothalamus; this feedback helps the hypothalamus monitor melatonin levels so that the appropriate amount of this hormone is released at different times of the day. Unfortunately, this carefully balanced system can be disrupted by artificial light sources, including our "smart" phones.

Figure 5.1 Pathways Involved in Circadian Rhythms

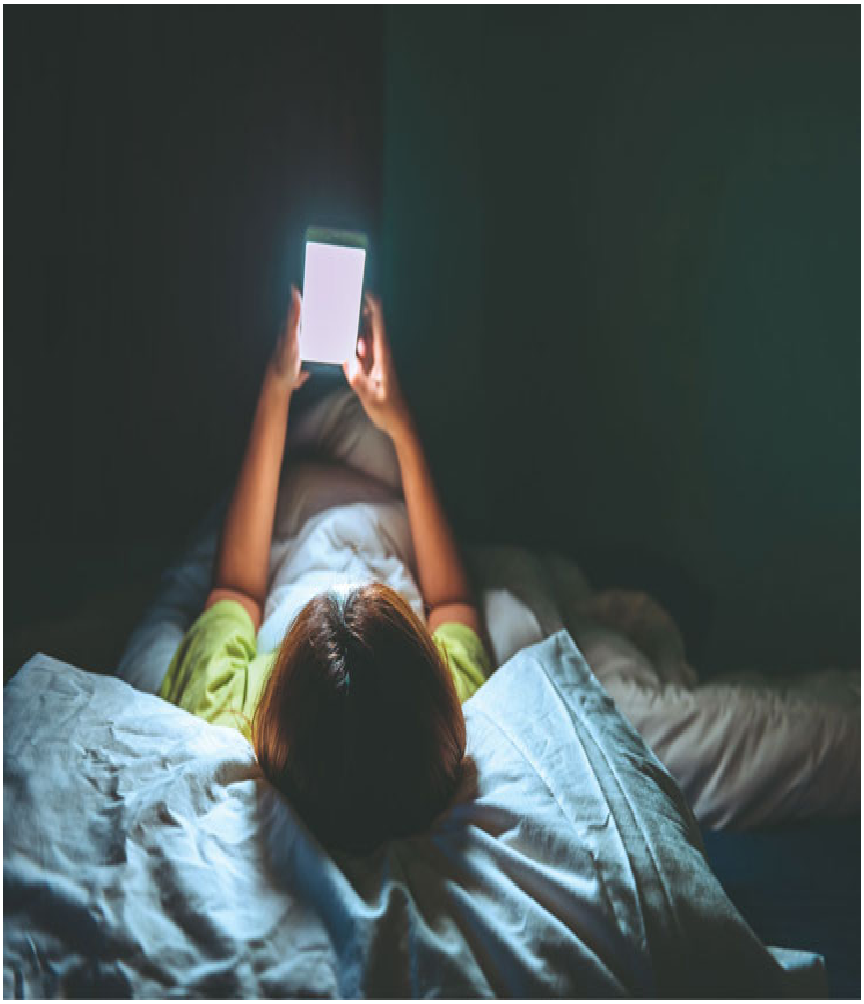


Cells in the retina send messages about light levels to the suprachiasmatic nucleus, which in turn relays the information to the pineal gland, which secretes melatonin.

#Psych

Using Your Smart Phone at Night

The typical North American adult spends over an hour a day on their phones (Christensen et al., 2016). We also tend to use our smart phones before going to bed, with some people even checking their phone if they wake up in the middle of the night. Research into smart phone use has shown that using our phones in the 30 minutes before going to bed has a negative effect on the duration and quality of sleep (Christensen et al., 2016). After reading the previous section of this module, you can likely guess one of the reasons for this: the SCN responds to light regardless of whether it is from the sun or from your phone. Recent research has shown that the blue light emitted from smart phones and ereaders leads to a decrease in the production of melatonin (Duffy & Czeisler, 2009; Holzmann, 2010). This change in melatonin disrupts circadian rhythms and can cause a person to be less alert the next day (Chang et al., 2015). This is why most sleep researchers recommend that people avoid the use of smart phones and other glowing rectangles in the 30 minutes prior to bed (Cain & Gradisar, 2010).



Smart phones allow people to access an almost infinite amount of information whenever they want it. Unfortunately, using smart phones at night can also disrupt a person's circadian rhythms.

kittirat roekburi/Shutterstock

This discussion of the sensitivity of circadian rhythms leads to an obvious question: what actually causes us to adopt these circadian rhythms in the first place? Why don't we stay awake for days and then sleep all weekend? There are two explanations for our 24-hour rhythms. One is **entrainment**, *when biological rhythms become synchronized to external cues*

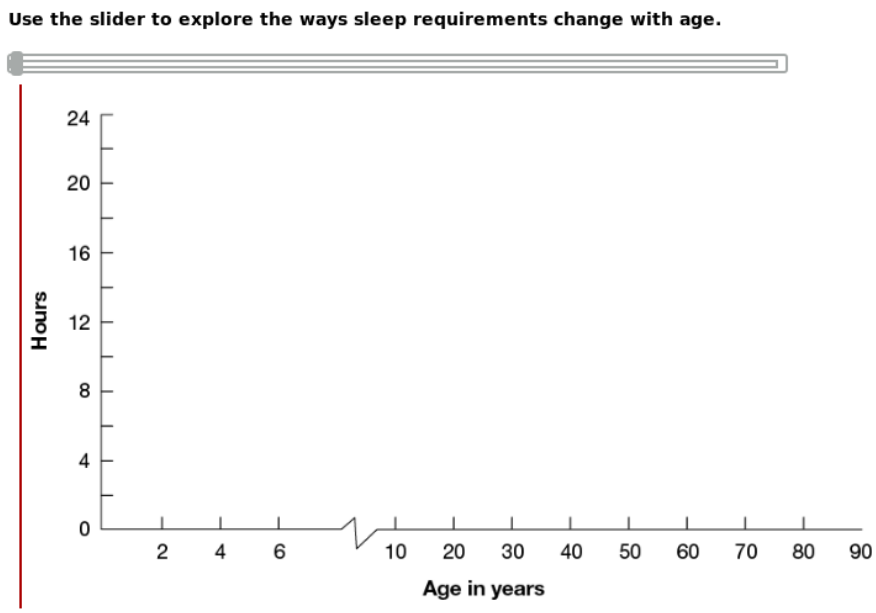
such as light, temperature, or even a clock. Because of its effects on the SCN-melatonin system, light is the primary entrainment mechanism for most mammals (Rusak, 1979; Wever et al., 1983). We tend to be awake during daylight and asleep during darkness. We're also influenced by the time on our clocks. If you're tired at 8 PM, you likely try to fight your fatigue until a "normal" bed time such as 10 PM. Why? Because we've been trained to believe that some times of day are associated with sleep and others are not.

However, not all of our body rhythms are products of entrainment. Instead, some are **endogenous rhythms**, *biological rhythms that are generated by our body independent of external cues such as light*. Studying endogenous rhythms is tricky because it is difficult to remove all of the external cues from a person's world. To overcome this problem, researchers in the 1960s and 1970s asked motivated volunteers to spend extended periods of time (months) in caves or in isolation chambers. For instance, Jürgen Aschoff (1965; Aschoff et al., 1967; Aschoff & Wever, 1962) had participants stay in an underground chamber for four weeks. He noted that individuals tended to adopt a 25-hour day. Michel Siffre, a French cave expert, remained by himself in a dark cave for much longer durations than Aschoff's participants: two months in 1962 and six months in 1972 (Foer & Siffre, 2008). Whenever he woke up or intended to go to sleep, he called his support team who were stationed at the entrance to the cave. Data from Siffre and a number of his subsequent participants indicated that most people fell into a 24.5-hour circadian rhythm. Although a few participants would briefly enter longer cycles—sometimes as long as 48-hour days—most people possess an endogenous circadian rhythm that is 24–25 hours in length (Lavie, 2001; Mills, 1964).

Although our sleep–wake cycle remains relatively close to 24 hours in length throughout our lives, some patterns within our circadian rhythms do change with age (Caci et al., 2009). As shown in Figure 5.2,

researchers have found that we need much less sleep—especially a type called REM sleep—as we move from infancy and early childhood into adulthood. Moreover, people generally experience a change in when they prefer to sleep. In your teens and 20s, many of you have (or will) become night owls who prefer to stay up late and sleep in. When given the choice, most people in this age range prefer to work, study, and play late in the day, and then awake later in the morning (Galambos et al., 2013). Later in adulthood, many of you will find yourselves going to bed earlier and getting up earlier, and you may begin to prefer working or exercising before teenagers even begin to stir. These are examples of changes in **chronotype**, *the tendency to prefer sleeping earlier or later in a given 24-hour period*. Research shows that these patterns are more than just preferences: People actually do show higher alertness and cognitive functioning during their preferred time of day (Cavallera & Giudici, 2008; Hahn et al., 2012). For example, researchers in the United States found that adolescents who preferred staying up late rated themselves as feeling sleepier and as having poorer emotional regulation when tested during the school day (which starts before 9:00 AM) than "morning people" (Owens et al., 2016). Importantly, this difference emerged even though the evening chronotype group (i.e., the night owls) actually got the same overall amount of sleep as the morning people. At the other end of the age spectrum, researchers at the University of Toronto have found that when older adults (approximately 60 to 80 years of age) are tested later in the day as opposed to early in the morning, they have a greater difficulty separating new from old information (Hasher et al., 2002) and have a larger variability in their reaction times on a test in which they learned to pair together a digit and a symbol (Hogan et al., 2009). These results have implications for the cognitive testing older patients receive in hospitals; clearly, these individuals will appear healthier if tested in the morning as opposed to later in the day, when their bodies are preparing to go to sleep.

Figure 5.2 Sleep Requirements Change with Age



People tend to spend progressively less time sleeping as they age. The amount of a certain type of sleep, REM sleep, declines the most.

Source: Based on Ontogenetic Development of the Human Sleep–Dream Cycle, *Science 152*(3722): 604–619. 29 Apr 1966.

The Stages of Sleep

Listen to the Audio

We have already seen how sleep fits into the daily rhythm, but if we take a closer look, we will see that sleep itself has rhythms. In order to measure these rhythms, scientists use **polysomnography**, *a set of objective measurements used to examine physiological variables during sleep*. Some of the devices used in this type of study are familiar, such as one to measure respiration and a thermometer to measure body temperature. In addition, electrical sensors attached to the skin measure muscle activity around the eyes and other parts of the body. However, sleep cycles themselves are most often defined by the *electroencephalogram* (*EEG*), a device that measures brain activity using sensors attached to the scalp (see Module 3.4).

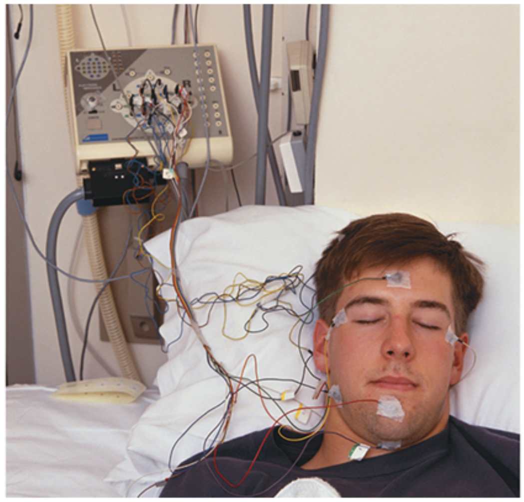
EEGs detect changes involving the ion channels on neurons. As you read in Module 3.2, ion channels are involved with receiving excitatory and inhibitory potentials from other cells and are also involved with the transmission of an action potential down the axon. Each EEG sensor would receive input from hundreds (possibly thousands) of cells. The output of an EEG is a waveform, like that shown in Figure 5.3, representing the overall activity of these groups of neurons. These waves can be described by their *frequency*—the number of up-down cycles every second—and their *amplitude*—the height and depth of the up-down cycle. *Beta waves*—high-frequency, low-amplitude waves (15–30 Hz)—are characteristic of wakefulness. Their irregular nature reflects the bursts of activity in different regions of the cortex, and they are often interpreted as

a sign that a person is alert. As the individual begins to shift into sleep, the waves start to become slower, larger, and more predictable; these *alpha waves* (8–14 Hz) signal that a person may be daydreaming, meditating, or starting to fall asleep. These changes in the characteristics of the waves continue as we enter deeper and deeper stages of sleep.

Watch Stages of Sleep

The EEG signals during sleep move through four different stages. In stage 1, brain waves slow down and become higher in amplitude—these are known as *theta waves* (4–8 Hz). Breathing, blood pressure, and heart rate all decrease slightly as an individual begins to sleep. However, at this stage of sleep, you are still sensitive to noises such as the television in the next room. After approximately 10 to 15 minutes, the sleeper enters stage 2, during which brain waves continue to slow. As shown in Figure 5.3, stage 2 includes *sleep spindles* (clusters of high-frequency but low-amplitude waves) and *K complexes* (small groups of larger amplitude waves), which are detected as periodic bursts of EEG activity. What these bursts in brain activity mean is not completely understood, but evidence suggests they may play a role in helping maintain a state of sleep and in the process of memory storage (Gais et al., 2002).

Figure 5.3 EEG Recordings during Wakefulness and Sleep



Using physiological recording devices, sleep researchers and doctors can monitor eye movements, brain waves, and other physiological processes.

1 of 6 Previous Next

Source: Hank Morgan/Photo Researchers, inc./Science Source

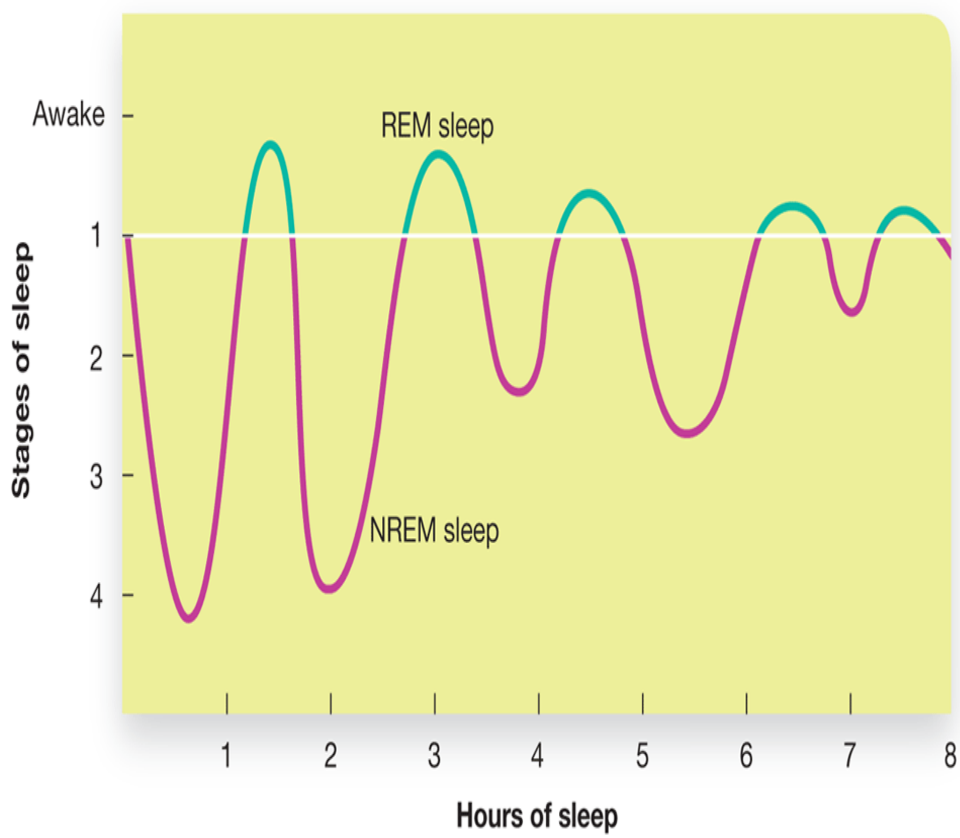
As stage 2 sleep progresses, we respond to fewer and fewer external stimuli, such as lights and sounds. Approximately 20 minutes later, we enter stage 3 sleep, in which brain waves continue to slow down and assume a new form called *delta waves* (large, looping waves that are high-amplitude and low-frequency—typically less than 3 Hz). The process continues with the deepest stage of sleep, stage 4, during which time the sleeper will be difficult to awaken.

About an hour after falling asleep, we reach the end of our first stage 4 sleep phase. At this point, the sleep cycle goes in reverse and we move back toward stage 2. From there, we move into a unique stage of **REM sleep**—*a stage of sleep characterized by quickening brain waves, inhibited body movement, and rapid eye movements* (*REM*). This stage is sometimes

known as *paradoxical sleep* because the EEG waves appear to represent a state of wakefulness despite the fact that we remain asleep. The REM pattern is so distinct that the first four stages are known collectively as *non-REM* (*NREM*) *sleep*. At the end of the first REM phase, we cycle back toward deep sleep stages and back into REM sleep again every 90 to 100 minutes. (Think back to the beginning of this module: What type of biological rhythm would a 90- to 100-minute cycle represent?)

The sleep cycle through a typical night of sleep is summarized in Figure 5.4. As shown in the figure, the deeper stages of sleep (3 and 4) predominate during the earlier portions of the sleep cycle, but gradually give way to longer REM periods.

Figure 5.4 Order and Duration of Sleep Stages through a Typical Night



Our sleep stages progress through a characteristic pattern. The first half of a normal night of sleep is dominated by deep, slow-wave sleep. REM sleep increases in duration relative to deep sleep during the second half of the night.

Source: Based on *Some Must Watch while Some Must Sleep* by W.D. Dement. WC Freeman & Company, 1974. URL: http://socrates.berkeley.edu/~kihlstrm/ConsciousnessWeb/SleepDreams/images/DementSuccession.JPG.

Why Do We Need Sleep?

Listen to the Audio

Sleep is such a natural part of life that it is difficult to imagine what the world would be like if there were no such thing. It raises another question: Why do humans and other animals need to sleep in the first place?

Theories of Sleep

Listen to the Audio

The most intuitive explanation for why we sleep is probably the **restore and repair hypothesis**, *the idea that the body needs to restore energy levels and repair any wear and tear experienced during the day's activities*. Research on sleep deprivation clearly shows that sleep is a physical and psychological necessity, not just a pleasant way to relax. A lack of sleep eventually leads to cognitive decline, emotional disturbances, and impaired functioning of the immune system (Born et al., 1997). It appears that sleeping helps animals, including humans, clear waste products and excess proteins from the brains. In a study using rodents, the researchers found that the pathways of the brain's waste removal system were enlarged during sleep, making the removal of these waste products more efficient. This effect was largest when the animal was sleeping on its side (Lee, Xie, et al., 2015). Such findings may explain why for some species, sleep deprivation can be as dangerous as food deprivation (Rechtschaffen, 1998).

A second explanation for sleep, the **preserve and protect hypothesis**, *suggests that two more adaptive functions of sleep are preserving energy and protecting the organism from harm* (Berger & Philips, 1995; Siegel, 2005). To support this hypothesis, researchers note that animals most vulnerable to predators sleep in safe hideaways during the time of day when their predators are most likely to hunt (Siegel, 1995). Because humans are quite dependent upon vision, it made sense for us to sleep at night, when we would be at a disadvantage compared to nocturnal predators. The

quantity of sleep required differs among animal species. Hoofed species like antelope (the species you always see getting killed in nature programs) sleep less than four hours per day, primarily because they have to remain alert in case a predator attacks. Conversely, animals such as lions and bears rarely fall victim to predators and can therefore afford a luxurious 15 hours of sleep per day. The underlying message from this theory is that each species' sleep patterns have evolved to match their sensory abilities and their environment.

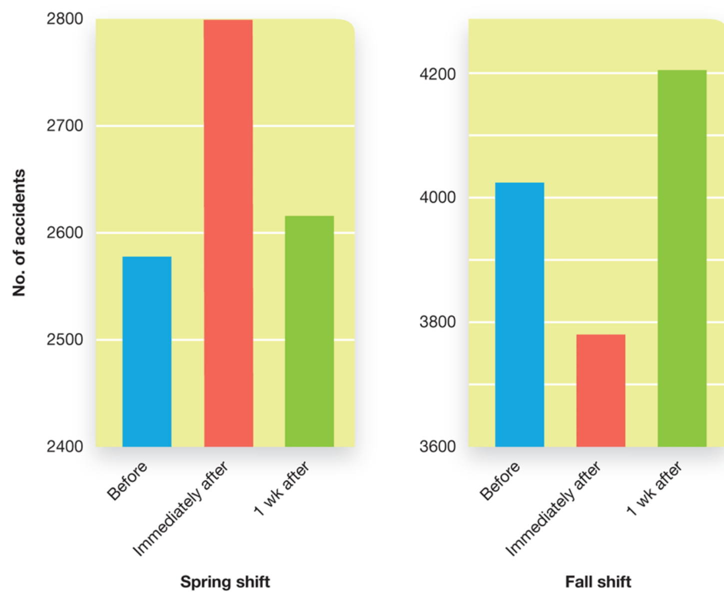
Thus, there are complementary theories that answer the question of why we sleep. The amount that any animal sleeps is a combination of its need for restoration and repair along with its need for preservation and protection. Each theory explains part of our reasons for drifting off each night. Importantly, both theories would produce sleep patterns that would improve a species' evolutionary fitness. Of course, this discussion of the reasons for sleep leads to an equally important discussion, particularly for students: What happens when we don't get enough sleep?

Sleep Deprivation and Sleep Displacement

Listen to the Audio

Chances are you have experienced disruptions to your sleep due to jet lag or to an "occasional late night" (i.e., life as a student), and we've all had that awful feeling in the spring when we are robbed of a precious hour of slumber by daylight saving time. We don't usually think of time shifts as being anything more than an annoyance. However, researchers have found that switching to daylight saving time in the spring costs workers an average of 40 minutes of sleep and significantly increases work-related injuries on the Monday following the time change (Barnes & Wagner, 2009). The same analysis showed that returning to standard time in the fall produces no significant changes in sleep or injuries. Similar results have been noted for traffic accidents. Stanley Coren at the University of British Columbia found that there was a significant increase in the number of accidents immediately following the "spring forward," but not after the "fall back" (1996a; see Figure 5.5). Coren also looked at accidental deaths unrelated to car accidents (Coren, 1996b). Using U.S. data from 1986 to 1988, he found a 6.6% increase in accidental deaths in the four days following the "spring forward" of daylight saving time. A more recent study using U.S. data from 2002 to 2011 concluded that daylight saving time led to 30 additional deaths (Smith, 2016). Importantly, the effects of disrupted sleep aren't limited to clumsiness; a substantial amount of research has shown that it can affect our thinking and decision making as well (Lavie, 2001).

Figure 5.5 Car Accident Statistics for the Years 1991 and 1992



These data represent the number of car accidents on the Monday before, the Monday immediately after, and the Monday one week after the spring and fall time changes. Note the dramatic increase in accidents immediately following the spring time change, when we lose one hour of sleep. Astute observers will also note that, overall, there were still more accidents in the fall than in the spring (the *y*-axes are different in the two graphs); this is likely due to the inclement weather found in many parts of Canada in October. Poor weather and earlier darkness are also the most likely explanations for the spike in accidents one week after the fall shift (green bar). These data are from the Canadian Ministry of Transport (and exclude Saskatchewan, which doesn't observe daylight saving time).

Source: From *The New England Journal of Medicine* by Stanley Coren, Daylight Savings Time and Traffic Accidents, *344*(14), 924. Copyright © 1996 Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society.

Sleep deprivation *occurs when an individual cannot or does not sleep*. In other words, it can be due to some external factor that is out of your control (e.g., noisy neighbours) or to some self-inflicted factor (e.g., studying, staying up late with friends, etc.). Exactly how sleep deprivation affects daily functioning has been the subject of scientific inquiry since 1896, when researchers examined cognitive abilities in people kept awake for 90 consecutive hours (Patrick & Gilbert, 1896). In almost all of the studies in the past century, the strength of the circadian rhythms was

evident; the volunteers generally went through cycles of extreme sleepiness at night, with relatively normal levels of wakefulness in the daytime (especially the afternoon). However, each night saw an increasing level of sleepiness, likely as an attempt by the body to preserve and protect the health of the individual from the consequences of sleep deprivation, such as the degeneration of neurons in the brainstem (Zhang et al., 2014).

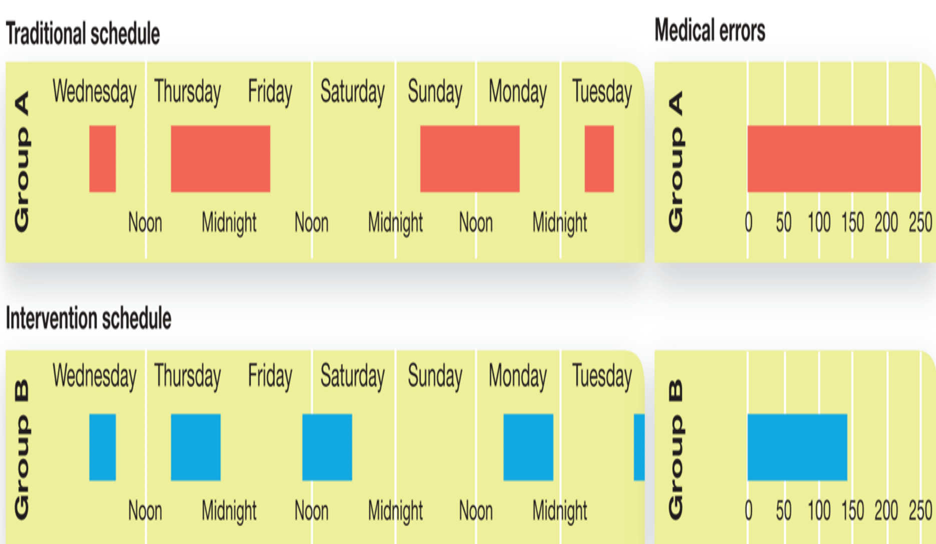
In addition to feelings of fatigue, researchers have discovered a number of specific impairments resulting from being deprived of sleep. These include difficulties with multitasking, maintaining attention for long periods of time, assessing risks, incorporating new information into a strategy (i.e., "thinking on the fly"), working memory (i.e., keeping information in conscious awareness), inhibiting responses, and keeping information in the correct temporal order (Durmer & Dinges, 2005; Lavie, 2001; Wimmer et al., 1992). Importantly, these deficits also appear after partial sleep deprivation, such as when you don't get enough sleep (Cote et al., 2008). In fact, cognitive deficits typically appear when individuals have less than seven hours of sleep for a few nights in a row (Dinges, 2006; Dinges et al., 2005).

The problems associated with sleep deprivation aren't limited to your ability to think. Research with adolescents shows that for every hour of sleep deprivation, predictable increases in physical illness, family problems, substance abuse, and academic problems occur (Roberts et al., 2009). Issues also arise with your coordination, a problem best seen in studies of driving ability. Using a driving simulator, researchers found that participants who had gone a night without sleeping performed at the same level as people who had a blood-alcohol level of 0.07 (Fairclough & Graham, 1999). A study of professional truck drivers accustomed to long shifts found that going 28 hours without sleep produced driving abilities similar to someone with a blood-alcohol level of 0.1, which is above the

legal limit throughout North America (Williamson & Feyer, 2000). Given that sleep deprivation is as dangerous as driving while mildly intoxicated (Dawson & Reid, 1997; Maruff et al., 2005), it is not surprising that it is one of the most prevalent causes of fatal traffic accidents (Lyznicki et al., 1998; Sagberg, 1999).

Sleep deprivation has led to some serious errors in the medical field as well. For instance, researchers at Harvard noted a number of critical errors by medical interns who were tired, including draining the wrong lung, prescribing a medication dose 10 times higher than it should have been, and causing an accidental overdose of benzodiazepines (Landrigan et al., 2004). Exhausted medical interns were also more likely to crash their cars on the way home (Barger et al., 2005) and suffer from job stress and burnout (Chen, Vorona, et al., 2008). These findings have motivated some researchers to investigate potential benefits of alternative work schedules. By limiting the length of shifts and reducing the number of hours worked per week, the number of medical errors decreased by 36% (Figure 5.6; Landrigan et al., 2004).

Figure 5.6 The Costly Effects of Sleep Deprivation



The traditional schedule of a medical intern (Group A) requires up to a 31-hour on-call shift, whereas the modified schedule (Group B) divides the 31 hours into two shorter shifts. The latter schedule reduces the effects of prolonged sleep deprivation as measured in terms of medical errors.

Source: From Effect of Reducing Interns' Work Hours on Serious Medical Errors in Intensive Care Units by C. P. Landrigan et al. (2004), *New England Journal of Medicine*, *351*(18), 1838–1848.

Cognitive and coordination errors are not limited to situations involving full or partial sleep deprivation. They can also occur when *the timing* of our sleep is altered. This phenomenon, **sleep displacement**, *occurs when an individual is prevented from sleeping at the normal time although she may be able to sleep earlier or later in the day than usual*. For example, consider a man from balmy Winnipeg who flies to London (U.K.) for a vacation. The first night in London, he may try to go to bed at his usual 12 AM time. However, his body's rhythms will be operating six hours earlier—they are still at 6 PM Winnipeg time. If he is like most travellers, this individual will experience sleep displacement for three or four days until he can get his internal rhythms to synchronize with the external day–night cycles. **Jet lag** *is the discomfort a person feels when sleep cycles are out of synchronization with light and darkness* (Arendt, 2009). How much jet lag people experience is related to how many time zones they cross and how quickly they do so (e.g., driving versus flying). Also, it is typically easier to adjust when travelling west. When travelling east, a person must try to fall asleep earlier than usual, which is difficult to do. Most people find it easier to stay up longer than usual, which is what westward travel requires.

Although jet lag has limited implications for our lives (unless you happen to be a pilot or a flight attendant who crosses oceans several times a month), many people will at some point in their lives have jobs that require shift work. In many hospitals, nurses and support staff rotate

across three different 8-hour shifts over the course of a month (e.g., midnight–8 AM, 8 AM–4 PM, 4 PM–midnight). Switching shifts requires a transition similar to jet lag; your day is suddenly altered by several hours. In order to better adapt to these changes, companies and hospitals are increasingly scheduling the shift rotations so that workers are able to stay up later (similar to travelling westward in the jet lag example). This reduces the negative effects on a worker's sleep patterns, which reduces the symptoms of sleep deprivation, thus giving the employer a more alert (and friendlier) employee.

It is important to note that sleep deprivation is not always caused by external factors such as world travel or tough work schedules; in fact, it can be caused by our own behaviours. One possible cause of sleep deprivation is consuming caffeine before bedtime. A 49-day study of five individuals found that consuming caffeine—in this case a double espresso—prior to going to bed delayed their internal clock by 40 minutes (Burke et al., 2015). This shift was twice as large as that caused by exposure to bright lights. (These participants were obviously dedicated and patient people.) A follow-up examination of the cellular mechanisms of this effect found that caffeine influences the levels of cyclic AMP, a molecule involved in the brain's internal clock. The good news is that the effects of caffeine on your circadian rhythms—and the cognitive impairments that go with it—are entirely under your control. The next time you spend an evening at Starbucks with your favourite psychology textbook, order a decaf.

Theories of Dreaming

Listen to the Audio

It is very difficult to think about sleeping without thinking about dreaming. Dreams are mysterious and have captured our imaginations for most of human history. A study of 1348 Canadian university students found that some patterns emerge when we analyze the *content* of our dreams. Using a statistical technique called factor analysis, researchers found that students' dreams can be reduced to 16 factors or subtypes. Females tended to have a larger number of negative dreams related to failures, loss of control, and frightening animals. Males, on the other hand, had more positive dreams, including those related to magical abilities and encounters with alien life (Nielsen et al., 2003). However, studies such as this one, despite being conducted properly, do not provide insight into the purpose(s) dreams serve in our lives.

The Psychoanalytic Approach

Listen to the Audio

One of the earliest and most influential theories of dreams was developed by Sigmund Freud in 1899. His classic work, *The Interpretation of Dreams*, dramatically transformed the Western world's view of both the function and meaning of dreams. Although many ancient societies performed dream interpretations, most viewed the content of dreams as representing connections to specific gods, as omens (good or bad), or as predictors of the future. In contrast, Freud viewed dreams as an unconscious expression of *wish fulfillment*. He believed that humans are motivated by primal urges, with sex and aggression being the most dominant. Because giving in to these urges is impractical most of the time (not to mention potentially immoral and illegal), we learn ways of keeping these urges suppressed and outside of our conscious awareness. When we sleep, however, we lose the power to suppress our urges. Without this active suppression, these drives are free to create the vivid imagery found in our dreams. This imagery can take two forms. **Manifest content** involves *the images and storylines that we dream about*. In many of our dreams, the manifest content involves sexuality and aggression, consistent with the view that dreams are a form of wish fulfillment. However, in other cases, the manifest content of dreams might seem like random, bizarre images and events. Freud would argue that these images are anything but random; instead, he believed they have a hidden meaning. This **latent content** is *the actual symbolic meaning of a dream built on suppressed sexual or aggressive urges*. Because the true meaning of the dream is latent, Freud advocated *dream work*, the recording and interpreting of dreams. Through

such work, Freudian analysis would allow you to bring the previously hidden sexual and aggressive elements of your dreams into the forefront, although it might mean you'd never look at the CN Tower the same way again.

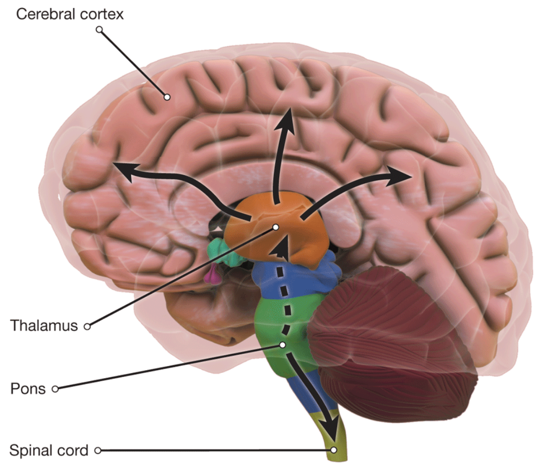
It is difficult to overstate the influence that Freud's ideas have had on our culture's beliefs about dreaming. There is an abundance of books offering insights into interpreting dreams, including dictionaries that claim to define certain symbols found in a dream's latent content. However, it is important to note that the scientific support for Freud's work is quite limited. Although his theories are based on extensive interviews with patients, many of these theories are difficult to test in a scientific manner because they cannot be falsified (i.e., there is no way to prove them wrong). Moreover, dream work requires a subjective interpreter to understand dreams rather than using objective measures. Therefore, the analysis of your dream might have more to do with the mindset of the analyst than it does your own hidden demons. Not surprisingly, modern dream research focuses much more on the biological activity of dreaming. These studies focus primarily on REM sleep, when dreams are most common and complex.

The Activation–Synthesis Hypothesis

Listen to the Audio

Freud saw deep psychological meaning in the latent content of dreams. In contrast, the **activation–synthesis hypothesis** *suggests that dreams arise from brain activity originating from bursts of excitatory messages from the pons, a part of the brainstem* (Hobson & McCarley, 1977). This electrical activity produces the telltale signs of eye movements and patterns of EEG activity during REM sleep that resemble wakefulness; moreover, the burst of activity stimulates the occipital and temporal lobes of the brain—producing imaginary sights and sounds—as well as numerous other regions of the cortex (see Figure 5.7). Thus, the brainstem initiates the *activation* component of the model. The *synthesis* component arises as different areas of the cortex of the brain try to make sense of all the images, sounds, emotions, and memories created by this activation (Hobson et al., 2000). Imagine having a dozen people each provide you with one randomly selected word, with your task being to organize these words to look like a single message; this is essentially what your cortex is doing every time you dream. Because we are often able to turn these random messages into a coherent story, researchers assume that the frontal lobes—the region of the brain associated with forming narratives—play a key role in the synthesis process (Eiser, 2005).

Figure 5.7 The Activation–Synthesis Hypothesis of Dreaming



The pons, located in the brainstem, sends excitatory messages through the thalamus to the sensory and emotional areas of the cortex. The images and emotions that arise from this activity are then woven into a story. Inhibitory signals are also relayed from the pons down the spinal cord, which prevents movement during dreaming.

The activation–synthesis model, although important in its own right, has some interesting implications. If the cortex is able to provide (temporary) structure to input from the brainstem and other regions of the brain, then that means the brain is able to work with and restructure information while we dream. If that is the case, then is it possible that the neural activity involved with dreaming also influences our ability to learn new information?

Working the Scientific Literacy Model

Dreams, REM Sleep, and Learning

Listen to the Audio

The activation–synthesis model of dreaming suggests that our dreams result from random brainstem activity that is organized—to some degree—by the cortex. Although this theory is widely accepted, it doesn't provide many specifics about the *purpose* of dreams. *Why* do we have these processes occurring and what functions do they serve? Dream researcher Rosalind Cartwright (Cartwright et al., 2006; Webb & Cartwright, 1978) proposed the **problem-solving theory**—*the theory that thoughts and concerns are continuous from waking to sleeping, and that dreams may function to facilitate finding solutions to problems encountered while awake*. This theory suggests that many of the images and thoughts we have during our dreams are relevant to the problems that we face when we are awake. For instance, researchers have found that individuals who are in poor physical health have more dreams about pain, injuries, illnesses, and medical themes than do healthy individuals (King & DeCicco, 2007). However, although no one doubts that our daily concerns find their way into our dreams, the problem-solving theory does not explain if (or how) any specific cognitive mechanisms are influenced by dreaming. Research into REM sleep performed by Canadian researchers may provide some answers.

What do we know about dreams, REM sleep, and learning?

Approximately 20%–25% of our total sleep time is taken up by REM, or rapid eye movement, sleep. When we are deprived of REM sleep, we typically experience a phenomenon called *REM rebound*—our brains spend increased time in REM-phase sleep when given the chance. The fact that our bodies actively try to catch up on missed REM sleep suggests that it may serve an important function.

As discussed earlier in this module, REM sleep produces brainwaves similar to being awake, yet we are asleep (Aserinsky & Kleitman, 1953). This similarity suggests that the types of functions being performed by the brain are likely similar during the two states. Studies with animals have shown that REM sleep is associated with a number of different neurotransmitter systems, all of which influence activity in the brainstem. Projections from the brainstem can then affect a number of different functions, including movement (which is inhibited), emotional regulation (through connections to the amygdala and frontal lobes), and learning (Brown et al., 2012). Clearly REM is not simply about twitching eyes! The challenge for psychologists is to determine the specific functions that are, and are not, affected by REM.

How can science explain the effects of dreams and REM sleep on learning?

In the past 30 years, scientists have performed an extraordinary number of experiments in an attempt to understand how REM sleep (and possibly dreaming) influences our thinking. The results of these studies show that REM sleep affects some, but not all, types of memory. If someone were to give you a list of words to remember and then tested you later, this would be an example

of *declarative memory* (see Module 7.1). The effect of REM sleep disruption on declarative memory was tested in a study conducted by Carlyle Smith at Trent University. Different groups of participants had only their REM sleep disrupted, only their non-REM sleep disrupted, or all of their sleep disrupted. When their memory for the words was tested, there were no differences among the groups, suggesting that REM sleep is not critical for this simple type of memory. However, when researchers gave participants tests that involved a larger number of steps or procedures, a different pattern of results emerged: Being deprived of REM sleep produced large deficits in performance (Smith, 2001).

Several studies have shown that the amount of REM sleep people experience increases the night after learning a new task (Smith et al., 2004). In a study directly related to students' lives, Smith and Lapp (1991) measured REM sleep three to five days after senior undergraduate students had completed their fall semester final exams. These students had more REM sleep episodes and a greater REM sleep density than they had when they were tested in the summer, when less learning was taking place. They also had higher sleep-density values than age-matched participants who were not in university. These results suggest that REM sleep may help us consolidate or maintain newly learned information.

Research has also demonstrated that REM sleep and dreaming influence our ability to problem solve. Depriving people of REM sleep reduces their ability to perform a complex logic task (Smith, 1993), which may be due to the fact that our ability to form new associations increases during REM sleep (Stickgold et al., 1999; Walker et al., 2002). Indeed, REM sleep, as opposed to non-REM sleep, helps people think creatively to find associations between words (Cai et al., 2009). REM sleep appears to be involved with

linking together steps in the formation of new memories and in reorganizing information in novel ways.

Can we critically evaluate this evidence?

We have to be cautious when we consider the effects that REM sleep, and perhaps dreaming, have on memory and problem solving. Although there is a great deal of evidence that REM sleep does influence a number of abilities, most of this research is correlational. As you've undoubtedly heard before, correlation does not equal causation. Therefore, we can't guarantee that REM sleep is *causing* the improvements in memory—just that its disruption *is related to* poor performance on a number of tasks. It is also unclear whether the observed effects are due to dreaming or to some other REM-related function.

In addition to these questions, it is also worth noting that the effects from these studies are not occurring during every period of REM sleep. When it comes to memory, not all REM sleep is created equal. The final few REM periods in the early morning appear to be critical for learning (Smith, 2001). Stickgold and colleagues (2000) found that performance on a visual search task (in which participants tried to find a particular target image that was hidden among distracter images, similar to *Where's Waldo?*) correlated with the amount of *non*-REM sleep a person had in the early part of the night and the amount of REM sleep in the early morning. Therefore, to say that REM sleep, in general, improves some types of learning is an over-simplification. Further research is needed to understand what makes these early morning windows of REM special.

Why is this relevant?

Studies of REM sleep and learning show us that the benefits of sleep go beyond restoring and repairing the body. Rather, the

effect(s) of REM sleep on our ability to learn new tasks should serve as a wake-up call to all of us. Almost everyone in a university setting—students *and* professors—is working on a less-than-optimal amount of sleep despite the fact that REM sleep is clearly an important part of our ability to learn. This seems counterproductive. Studying and sleeping every night is a much more effective way to retain information than pulling a frantic all-nighter just before an exam, even if we all feel like we're out of time.

Disorders and Problems with Sleep

Listen to the Audio

Throughout this module, we have seen that sleep is an essential biological and psychological process; without sleep, individuals are vulnerable to cognitive, emotional, and physical symptoms. Given these widespread effects, it should come as no surprise that a lot of research has been directed at improving our ability to diagnose and treat sleep disorders. In the final section of this module, we will discuss some of the more common sleep disorders.

Insomnia

Listen to the Audio

The most widely recognized sleeping problem is **insomnia**, *a disorder characterized by an extreme lack of sleep*. According to the 2011–2012 Canadian Community Health Survey from Statistics Canada, 17% of Canadian adults (6.3 million people) suffer from insomnia (Chaput et al., 2017). This represents a 1.5% increase from a 2002 Statistics Canada survey, with most of this change being due to a large increase in insomnia in middle-aged women (Garland et al., 2018). Although the average adult may need seven to eight hours of sleep to feel rested, substantial individual differences exist. For this reason, insomnia is defined not in terms of the number of hours of sleep, but rather in terms of the degree to which a person feels rested during the day. If a person feels that their sleep disturbance is affecting their schoolwork, job, or family and social life, then it is indeed a problem. However, for this condition to be thought of as a sleep *disorder*, it would have to be present for three months or more—one or two "bad nights" is unpleasant, but is not technically insomnia.

Although insomnia is often thought of as a single disorder, it may be more appropriate to refer to *insomnias* in the plural. *Onset insomnia* occurs when a person has difficulty falling asleep (30 minutes or more), *maintenance insomnia* occurs when an individual cannot easily return to sleep after waking in the night, and *terminal insomnia* or *early morning insomnia* is a situation in which a person wakes up too early—sometimes hours too early—and cannot return to sleep (Pallesen et al., 2001).

Insomnia can arise from worrying about sleep. Insomnia is among the most common of all sleep disorders.

Steve Prezant/Glow Images

It is important to remember that for a sleep disorder to be labelled insomnia, the problems with sleeping must be due to some internal cause; not sleeping because your roommate snores does not count as insomnia. Sometimes insomnia occurs as part of another problem, such as depression, pain, developmental disorders such as attention deficit hyperactivity disorder (ADHD), or various drugs (Corkum et al., 2014; Schierenbeck et al., 2008); in these cases, the sleep disorder is referred to as a *secondary insomnia*. When insomnia is the only symptom that a person is showing, and other causes can be ruled out, physicians would label the sleep disorder as *insomnia disorder*. If you think back to our earlier discussion of sleep deprivation, you can see why insomnia—despite not seeming serious—can have a profound effect on a person's

ability to function in our demanding world. However, it isn't the only disorder that can affect our ability to sleep a full eight hours each night.

Nightmares and Night Terrors

Listen to the Audio

Although most of our dreams are interesting and often bizarre, some of our dreams really scare us. **Nightmares** *are particularly vivid and disturbing dreams that occur during REM sleep*. They can be so emotionally charged that they awaken the individual (Levin & Nielsen, 2007). Almost everyone—as many as 85% to 95% of adults—can remember having bad dreams that have negative emotional content, such as feeling lost, sad, or angry, within a one-year period (Levin, 1994; Schredl, 2003). Data from numerous studies indicate that nightmares are correlated with psychological distress including anxiety (Nielsen et al., 2000; Zadra & Donderi, 2000), negative emotionality (Berquier & Ashton, 1992; Levin & Fireman, 2002), and emotional reactivity (Kramer et al., 1984). They are more common in females (Nielsen et al., 2006), likely because women tend to have higher levels of depression and anxiety disorders. Indeed, in individuals with emotional disorders, the "synthesis" part of dreaming appears to reorganize information in a way consistent with their mental state, with a focus on negative emotion.

Nightmares, although unpleasant, are a normal part of life. In contrast, 1% to 6% of children and 1% of adults experience **night terrors**—*intense bouts of panic and arousal that awaken the individual, typically in a heightened emotional state*. A person experiencing a night terror may call out or scream, fight back against imaginary attackers, or leap from the bed and start to flee before waking up. Unlike nightmares, night terrors are not dreams. These episodes occur during NREM sleep, and the majority of

people who experience them typically do not recall any specific dream content. Night terrors increase in frequency during stressful periods, such as when parents are separating or divorcing (Schredl, 2001). There is also some evidence linking them to feelings of anxiety, which suggests that for some sufferers, counselling and other means for reducing anxiety may help reduce the symptoms (Kales et al., 1980; Szelenberger et al., 2005).

Movement Disturbances

Listen to the Audio

To sleep well, an individual needs to remain still. During REM sleep, the brain prevents movement by sending inhibitory signals down the spinal cord. However, in some rare individuals, this inhibition does not occur. **REM behaviour disorder** *is a condition that does not show the typical restriction of movement during REM sleep; in fact, they appear to be acting out the content of their dreams* (Schenck & Mahowald, 2002). Imagine what happens when an individual dreams of being attacked—the dreamed response of defending oneself or even fighting back can be acted out. Not surprisingly, this action can awaken some individuals. Because it occurs during REM sleep, however, some individuals do not awaken until they have hurt themselves or someone else (Schenck et al., 1989). Fortunately, REM behaviour disorder can be treated with medication; benzodiazepines, which inhibit the central nervous system, have proven effective in reducing some of the symptoms associated with this condition (Paparrigopoulos, 2005). However, given the potential side effects of this class of drug, this option should only be taken if the person is a threat to themself or others.

A more common movement disturbance is **somnambulism**, or *sleepwalking, a disorder that involves wandering and performing other activities while asleep*. It occurs during NREM sleep, stages 3 and 4, and is more prevalent during childhood. Sleepwalking is not necessarily indicative of any type of sleep or emotional disturbance, although it may put people in harm's way. People who sleepwalk are not acting out

dreams, and they typically do not remember the episode. (For the record, it is not dangerous to wake up a sleepwalker, as is commonly thought. At worst, they will be disoriented.) There is no reliable medicine that curbs sleepwalking; instead, it is important to add safety measures to the person's environment so that the sleepwalker doesn't get hurt.

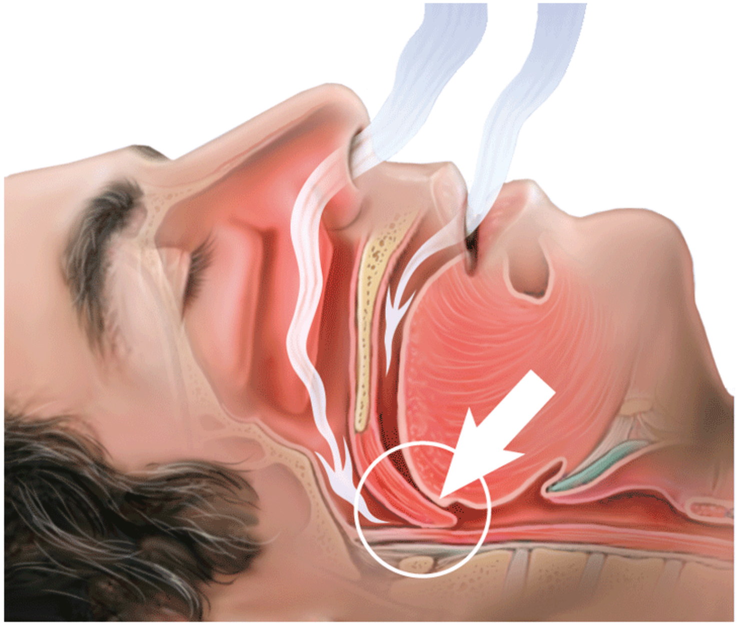
A similar, but more adult, disorder is *sexomnia* or *sleep sex*. Individuals with this condition engage in sexual activity such as the touching of the self or others, vocalizations, and sex-themed talk while in stages 3 and 4 sleep (Shapiro et al., 2003). In the original case report of this disorder (Motet, 1897, described in Thoinot, 1913), a man exposed his genitals to a policeman. He was unable to recall the incident afterwards and was sentenced to three months in jail. Other reports are more extreme, including sex with strangers and unwanted contact with sleeping partners (Béjot et al., 2010). Although this condition initially seems like a joke, it is no laughing matter to people who experience sexomnia, the individuals who experience unwanted sexual attention from someone with this disorder, or the legal system. Of the ten individuals who used sexomnia as a defence in a Canadian court, four were found guilty (Organ & Fedoroff, 2015). At present, the exact cause of sexomnia is unknown, although stress, fatigue, drug use, and a history of trauma have all been mentioned as possible factors (Dubessy et al., 2017; Schenck et al., 2007).

Sleep Apnea

Listen to the Audio

The disorders discussed thus far have focused on changes in the brain that lead to altered thinking patterns (nightmares and night terrors) and movements. In contrast, **sleep apnea** *is a disorder characterized by the temporary inability to breathe during sleep* (*apnea* literally translates to "without breathing"). Although a variety of factors contribute to sleep apnea, this condition appears to be most common among overweight and obese individuals, and it is roughly twice as prevalent among men as among women (Lin et al., 2008; McDaid et al., 2009). In most cases of apnea, the airway becomes physically obstructed at a point anywhere from the back of the nose and mouth to the neck (Figure 5.8). Therefore, treatment for mild apnea generally involves dental devices that hold the mouth in a specific position during sleep. Weight-loss efforts should accompany this treatment in cases in which it is a contributing factor. In moderate to severe cases, a continuous positive airway pressure (CPAP) device can be used to force air through the nose, keeping the airway open through increased air pressure (McDaid et al., 2009).

Figure 5.8 Sleep Apnea



One cause of sleep apnea is the obstruction of air flow, which can seriously disrupt the sleep cycle.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd Ed. Reprinted and electronically reproduced of Pearson Education, Inc., New York, NY.

In rare but more serious cases, sleep apnea can also be caused by the brain's failure to regulate breathing. This failure can happen for many reasons, including damage to or deterioration of the medulla of the brainstem, which is responsible for controlling the chest muscles during breathing.

You might wonder if disorders that stop breathing during sleep can be fatal. They can be, but rarely are. As breathing slows too much or stops altogether, oxygen levels in the blood rapidly decline, resulting in a gasping reflex and resumed oxygen flow. Actually, gasping may not even result in waking up. A person with sleep apnea may not be aware that he is constantly cycling through oxygen loss and gasping as he sleeps, although it would certainly be noticed by anyone sharing a bed with him. It is often the case that affected individuals discover that they have sleep

apnea only after visiting their physician to find a solution for their snoring and fatigue.

Although sleep apnea is serious in its own right, it also leads to a number of other problems. Repeatedly waking up during the night reduces the quality of an individual’s sleep and can lead to a mild form of sleep deprivation (Naëgelé et al., 1995). In fact, individuals who suffer from sleep apnea often perform more poorly on tests requiring mental flexibility, the control of attention, and memory (Fulda & Schulz, 2003). Treating sleep apnea will therefore not only improve a person’s physical safety and fatigue levels, but also the person’s ability to think.

Narcolepsy

Listen to the Audio

While movement disorders, sleep apnea, and night terrors can all lead to insomnia, another condition is characterized by nearly the opposite effect. **Narcolepsy** *is a disorder in which a person experiences extreme daytime sleepiness and even sleep attacks*. These bouts of sleep may last only a few seconds, especially if the person is standing or driving when she falls asleep and is jarred awake by falling, a nodding head, or swerving of the car. Even without such disturbances, the sleep may last only a few minutes or more, so it is not the same as falling asleep for a night's rest.

Narcolepsy differs from more typical sleep in a number of other ways. People with a normal sleep pattern generally reach the REM stage after more than an hour of sleep, but a person experiencing narcolepsy is likely to go almost immediately from waking to REM sleep. Also, because REM sleep is associated with dreaming, people with narcolepsy often report vivid dream-like images even if they did not fully fall asleep.

Why does narcolepsy occur? Scientists have investigated a hormone called *orexin* that functions to maintain wakefulness. Individuals with narcolepsy have fewer brain cells that produce orexin, resulting in greater difficulty maintaining wakefulness (Nakamura et al., 2011). Some individuals also experience attacks of narcolepsy when they experience intense emotions, such as when they laugh. Researchers suggest that in these individuals, the hypothalamus—which controls the release of orexin—does not exert control over brain areas related to emotion in the same

way that it does in most people's brains. An fMRI study found that these emotional brain areas, which included the amygdala, ventromedial (bottom, middle) prefrontal cortex, and nucleus accumbens (a reward centre), all showed increased activity during emotion-induced narcolepsy (Meletti et al., 2015). Luckily, medications are available to treat this condition, thus allowing these individuals to function relatively normally (Mayer, 2012).

Watch Sleep Disorders

Overcoming Sleep Problems

Listen to the Audio

Everyone has difficulty sleeping at some point, and there are many myths and anecdotes about what will help. For some people, relief can be as simple as a snack or a warm glass of milk; it can certainly be difficult to sleep if you are hungry. Others might have a nightcap—a drink of alcohol—in hopes of inducing sleep, although the effects can be misleading. Alcohol may make you sleepy, but it disrupts the quality of sleep, especially the REM cycle, and may leave you feeling unrested the next day.

Another drug that is frequently used to assist with sleep is marijuana. Many people who smoke marijuana use this drug to induce sleepiness. In fact, several studies have shown that people with sleep problems are at a greater risk of abusing marijuana than people who get enough sleep each night (e.g., Mike et al., 2016; Wong et al., 2015). It is also worth noting that using marijuana interferes with circadian rhythms (Lafaye et al., 2018) and disrupts REM sleep (Feinberg et al., 1976). Given these negative side effects *and* the fact that using marijuana as a sleep aid can be habit forming, most researchers recommend that people with sleeping problems find a less smoky solution (Furer et al., 2018).

Many people turn to over-the-counter drugs (e.g., sedatives) to help them sleep. A number of sleep aids are available on an over-the-counter basis, and several varieties of prescription drugs have been developed as well. For most of the 20th century, drugs prescribed for insomnia included

sedatives such as barbiturates (Phenobarbital) and benzodiazepines (e.g., Valium). Although these drugs managed to put people to sleep, several problems with their use were quickly observed. Notably, people quickly developed tolerance to these agents, meaning they required increasingly higher doses to get the same effect, and many soon came to depend on the drugs so much that they could not sleep without them (Pallesen et al., 2001). Modern sleep drugs are generally thought to be much safer in the short term, and many have been approved for long-term use as well. However, few modern drugs have been studied in placebo-controlled experiments, and even fewer have actually been studied for long-term use (e.g., for more than a month; Krystal, 2009).

Fortunately, most people respond very well to psychological interventions. By practising good *sleep hygiene*—healthy sleep-related habits—they can typically overcome sleep disturbances in a matter of a few weeks (Morin et al., 2006; Murtagh & Greenwood, 1995). The techniques shown in Table 5.1 are effective for many people who prefer self-help methods, but effective help is also available from psychologists, physicians, and even (sometimes) on the internet (Ritterband et al., 2009; van Straten & Cuijpers, 2009). So, rather than taking drugs to alter your brain chemistry, it is generally safer to change your sleep hygiene (sleeping routines) if you want to put your sleeping problems to rest.

Table 5.1 Nonpharmacological Techniques for Improving Sleep

Table 5.1 Nonpharmacological Techniques for Improving Sleep
1. Use your bed for sleeping only, not for working or studying. (Sexual activity is an appropriate exception to the rule.)
2. Do not turn sleep into work. Putting effort into falling asleep generally leads to arousal instead of sleep.
3. Keep your clock out of sight. Watching the clock increases pressure to sleep and worries about getting enough sleep.
4. Get exercise early during the day. Exercise may not increase the amount of sleep, but it may help you sleep better. Exercising late in the day, however, may leave you restless and aroused at bedtime.
5. Avoid substances that disrupt sleep. Such substances include caffeine (in coffee, tea, many soft drinks, and other sources), nicotine, and alcohol. Illicit drugs such as cocaine, marijuana, and ecstasy also disrupt healthy sleep.
6. If you lie in bed worrying at night, schedule evening time to deal with stress. Write down your worries and stressors for approximately 30 minutes prior to bedtime.
7. If you continue to lie in bed without sleeping for 30 minutes, get up and do something else until you are about to fall asleep, and then return to bed.
8. Get up at the same time every morning. Although this practice may lead to sleepiness the first day or two, eventually it helps set a daily rhythm.
9. If you still have problems sleeping after four weeks, consider seeing a sleep specialist to get tested for sleep apnea or other sleep problems that may require more specific interventions.

Source: Based on recommendations from the American Psychological Association, 2004.

Module 5.1 Summary

Listen to the Audio

5.1a Know . . . the key terminology associated with sleep, dreams, and sleep disorders.

Review Module 5.1

Start Over Swap

0/23 REVIEWED · 0 MASTERED

restore and repair hypothesis

Previous Next Got It!

5.1b Understand . . . how the sleep cycle works.

The sleep cycle consists of a series of stages going from stage 1 through stage 4, cycles back down again, and is followed by a REM phase. The first sleep cycle lasts approximately 90 minutes. Deep sleep (stages 3 and

4) is longest during the first half of the sleep cycle, whereas REM phases increase in duration during the second half of the sleep cycle.

5.1c Understand . . . theories of why we sleep.

Sleep theories include the restore and repair hypothesis and the preserve and protect hypothesis. According to the restore and repair hypothesis, we sleep so that the body can recover from the stress and strain on the body that occurs during waking. Waste products are more efficiently removed from the brain during this time as well. According to the preserve and protect hypothesis, sleep has evolved as a way to reduce activity and provide protection from potential threats, and to reduce the amount of energy intake required. Evidence supports both theories, so it is likely that there is more than one reason for sleep.

5.1d Apply . . . your knowledge to identify and practise good sleep habits.

Apply Activity

Try completing the Epworth Sleepiness Scale to make sure you are getting enough sleep (Table 5.2). If you score 10 points or higher, you are probably not getting enough sleep. You can always refer to Table 5.1 for tips on improving your sleep.

Table 5.2 Epworth Sleepiness Scale

Table 5.2 Epworth Sleepiness Scale

Situation	Chances of Falling Asleep
Sitting and reading	0 1 2 3
Watching TV	0 1 2 3
Sitting inactive in a public place	0 1 2 3
Being a passenger in a motor vehicle for an hour or more	0 1 2 3
Lying down in the afternoon	0 1 2 3
Sitting and talking to someone	0 1 2 3
Sitting quietly after lunch (no alcohol)	0 1 2 3
Stopped for a few minutes in traffic while driving	0 1 2 3
Your total score	

Use the following scale to choose the most appropriate number for each situation:
0 = would *never* doze or sleep 1 = *slight* chance of dozing or sleeping 2 = *moderate* chance of dozing or sleeping 3 = *high* chance of dozing or sleeping

Source: Reprinted with permission from SLEEP. Sleep Research Society, Darien, IL, USA 2016.

5.1e Analyze . . . different theories about why we dream.

Dreams have fascinated psychologists since Freud's time. From his psychoanalytic perspective, Freud believed that the manifest content of dreams could be used to uncover their symbolic, latent content. Contemporary scientists are skeptical about the validity of this approach given the lack of empirical evidence to support it. The activation–synthesis theory eliminates the meaning of dream content, suggesting instead that dreams are just interpretations of haphazard electrical activity in the sleeping brain that are then organized to some degree by the cortex. Increasing evidence suggests that REM sleep, the sleep stage

associated with dreaming, improves our ability to form new procedural (step-by-step) memories and to find solutions to problems.

Module 5.2 Altered States of Consciousness: Hypnosis, Mind-Wandering, and Disorders of Consciousness

Listen to the Audio

Gennadiy Poznyakov/Fotolia

Learning Objectives

5.2a Know . . . the key terminology associated with hypnosis, mind-wandering, and disorders of consciousness.

5.2b Understand . . . the competing theories of hypnosis.

5.2c Apply . . . your knowledge of hypnosis to identify what it can and cannot do.

5.2d Analyze . . . the effectiveness of using neuroimaging to study mind-wandering.

5.2e Analyze . . . the ability of researchers to detect consciousness in brain-damaged patients.

"Just a moment! I don't like the patient's colour. Much too blue. Her lips are very blue. I'm going to give a little more oxygen. . . . There, that's better now. You can carry on with the operation" (Levinson, 1965, p. 544). If you were undergoing surgery with a local anesthetic and heard this, you would certainly be worried . . . if not panicking. But what if you had been given general anesthetic so that you were "unconscious"? Presumably, you should be blissfully unaware of the fact that you were turning blue. However, when prompted by an experimenter one month later, eight of the 10 patients who heard these statements—which were in a script read during real surgeries as part of an experiment—were able to report back some elements of the fake crisis. Four of the patients were able to give an almost verbatim account of what the experimenter said. In other studies, post-operative patients were able to complete word stems (e.g., H O - - -) with words presented under anesthesia (e.g., HORSE, not HOUSE) at levels far above chance (Bonebakker et al., 1996; Merikle & Daneman, 1996). How is this possible? Brain imaging studies have noted that anesthesia affects more than just activity related to pain and touch; instead, it affects how different areas of the brain work together to form networks (MacDonald et al., 2015). Importantly, anesthesia seems to affect brain networks related to complex thought more than it affects networks related to auditory and visual perception (Boveroux et al., 2010; Liu et al., 2012). This difference may explain why anesthetized patients might, upon coming out of the anesthetic state, use the presented words to complete word stems even though they have no conscious recollection of their presentation.

It is important to note that these studies don't tell us what consciousness is. What these studies do illustrate, however, is that consciousness does not have a simple on/off switch. Instead, there are a number of possible states of consciousness, each with its own abilities and limitations.

Philosophers have attempted to understand the mysteries of consciousness for thousands of years. Recently, cognitive neuroscience researchers have used methods ranging from brain imaging to computer modelling to examine how the coordinated activity of groups of brain cells can produce our everyday conscious experiences (Crick, 1994; Koch et al., 2016). Although these investigations have shown great promise, many psychologists use a different strategy to study consciousness: examining situations in which consciousness is altered or impaired. By examining how our abilities and experiences change during altered states of consciousness, we can gain greater insight into our "normal" conscious behaviour. In this module, we will discuss three of these altered states—hypnosis, mind-wandering, and disorders of consciousness caused by brain damage.

Hypnosis

Listen to the Audio

The caricature of a hypnotist as an intense-looking bearded man swinging his glistening pocket watch back and forth before an increasingly subdued subject will probably always be around, though it promotes just one of many misunderstandings about hypnosis. **Hypnosis** is actually *a procedure of inducing a heightened state of suggestibility*. According to this definition, hypnosis is *not* a trance, as is often portrayed in the popular media (Kirsch & Lynn, 1998). Instead, the hypnotist simply suggests changes, and the subject is more likely (but not certain) to comply as a result of the suggestion.

Although one could conceivably make suggestions about almost anything, hypnotic suggestions generally are most effective when they fall into one of three categories:

- *Ideomotor suggestions* are related to specific actions that could be performed, such as adopting a specific position.
- *Challenge suggestions* indicate actions that are not to be performed, so that the subject appears to lose the ability to perform an action.
- *Cognitive-perceptual suggestions* involve a subject remembering or forgetting specific information, or experiencing altered perceptions such as reduced pain sensations (Kirsch & Lynn, 1998).

People who have not encountered scientific information about hypnosis are often skeptical that hypnosis can actually occur or are very reluctant

to be hypnotized themselves (Capafons et al., 2008; Molina & Mendoza, 2006). It is important to note that hypnotists cannot make someone do something against their will. For example, the hypnotist could not suggest that an honest person rob a bank and expect the subject to comply. Instead, the hypnotist can increase the likelihood that subjects will perform simple behaviours that they have performed or have thought of before, and would be willing to do (in some contexts) when in a normal conscious state.

Check Your Understanding: **The Three Types of Hypnotic Suggestions**

Match the **three types of hypnotic suggestion**s with their definitions:

Hypnotic Suggestions	Definitions
Ideomotor suggestions	related to specific actions that could be performed, such as adopting a specific position.
Challenge suggestions	indicate actions that are not to be performed, so that the subject appears to lose the ability to perform an action.
Cognitive-perceptual suggestions	involve a subject remembering or forgetting specific information, or experiencing altered perceptions such as reduced pain sensations (Kirsch & Lynn, 1998).

Check Your Understanding

Theories of Hypnosis

Listen to the Audio

In the previous section, we discussed the types of behaviours that can and cannot be influenced by hypnosis; in this section, we attempt to uncover how this process actually works. The word *hypnosis* comes from the Greek word *hypno*, meaning “sleep.” In reality, scientific research tells us that hypnosis is nothing like sleep. Instead, hypnosis is based on an interaction between (1) automatic (unconscious) thoughts and behaviours and (2) a supervisory system (Norman & Shallice, 1986), sometimes referred to as *executive processing*, that is involved in processes such as the control of attention and problem solving. The roles played by these two pieces of the puzzle differ across theories of hypnosis.

Stage hypnotists often use the human plank demonstration with their subjects. They support an audience volunteer on three chairs. To the audience's amazement, when the chair supporting the mid-body is removed, the hypnotized subject does not fall (even when weight is added, as shown in the photo). However, non-hypnotized subjects also do not fall. (Please do not try this at home—there is a trick behind it!)

Bookstaver/AP Images

Dissociation theory *explains hypnosis as a unique state in which consciousness is divided into two parts: a lower-level system involved with perception and movement and an "executive" system that evaluates and monitors these behaviours* (Hilgard, 1986; Woody & Farvolden, 1998). It may sound magical, but this kind of divided state is actually quite common. Take any skill that you have mastered, such as driving a car or playing an instrument. When you began, it took every bit of your conscious awareness to focus on the correct movements—you were a highly focused observer of your actions. In this case, your behaviour required a lot of executive processing. After a few years of practice, you

can do it automatically while you observe and pay attention to something else. In this case, you require much less executive processing. Although we call the familiar behaviour automatic, part of you is still paying attention to what you are doing in case you suddenly need to change your behaviour. During hypnosis, there appears to be a separation between these two systems. As a result, actions or thoughts suggested by the hypnotist may bypass the evaluation and monitoring system and go directly to the simpler perception and movement systems (Landry & Raz, 2015). In other words, suggestible individuals will experience *less* input from the executive system (Jamieson & Sheehan, 2004; Woody & Bowers, 1994). In support of this view, neuroimaging studies have found reduced activity in the anterior cingulate cortex, a region of the frontal lobe related to executive functions, in hypnotized subjects (McGeown et al., 2009; Raz et al., 2005).

A second approach, **social-cognitive theory**, *explains hypnosis by emphasizing the degree to which beliefs and expectations contribute to increased suggestibility*. This perspective is supported by experiments in which individuals who are not yet hypnotized are told either that they will be able to resist ideomotor suggestions or that they will not be able to resist them. In these studies, people tend to conform to what they have been told to expect—a result that cannot be easily explained by dissociation theory (Lynn et al., 1984; Spanos et al., 1985). Similarly, research on hypnosis as a treatment for pain shows that *response expectancy*—whether the individual believes the treatment will work—plays a large role in the actual pain relief experienced (Milling, 2009).

At this point, there appears to be some evidence in favour of both theories. It is possible that expectations might make some people more likely to enter a hypnotic state, but once they enter it, they act in a way consistent with the dissociation theory. These expectations may be why people are more likely to enter a hypnotic state under the guidance of a

hypnotist than with a non-hypnotist. However, the exact relationship (if any) between these two theories remains unclear. This lack of clarity is due to the fact that hypnosis did not receive much scientific attention for most of the 20th century. However, despite the fact that there is not a clear answer as to how hypnosis works, most scientists agree that for *some* individuals hypnosis can be a powerful therapeutic tool.

Applications of Hypnosis

Listen to the Audio

Although it is used far less frequently than medications or talk-based therapies, hypnosis has been used to treat a number of physical and psychological conditions. Hypnosis is often used in conjunction with other psychotherapies such as cognitive-behavioural therapy (CBT; see Module 16.2) rather than as a stand-alone treatment. The resulting *cognitive hypnotherapy* has been used as an effective treatment for depression (Alladin & Alibhai, 2007), anxiety (Abramowitz et al., 2008; Schoenberger et al., 1997), eating disorders (Barabasz, 2007), hot flashes of cancer survivors (Elkins et al., 2008), and irritable bowel syndrome (Golden, 2007), among many others (M. R. Nash et al., 2009). Hypnosis is far from a cure-all, however. For example, researchers found that hypnotherapy combined with a nicotine patch is more effective as a smoking cessation intervention than the patch alone. Nonetheless, only one-fifth of the individuals receiving this kind of therapy managed to remain smoke-free for a year (Carmody et al., 2008). Moreover, although some therapists combine hypnotherapy with traditional cognitive behavioural therapy when treating depression, much more research is required before this technique becomes a standard treatment (Alladin, 2012). The best conclusion regarding hypnosis in therapy is that it shows promise, especially when used in conjunction with other evidence-based psychological or medical treatments.

Perhaps the most practical use for hypnosis is in the treatment of pain. If researchers can demonstrate its effectiveness in this application, it may be

a preferred method of pain control given painkillers′ potential side effects and the risk of addiction. What does the scientific evidence say about the use of hypnosis in treating pain? Reviews of studies examining hypnosis and pain suggest that between 60 and 75% of individuals experienced pain relief from hypnosis (Kendrick et al., 2017; Montgomery et al., 2000). What happened to the other 25% to 40%? Perhaps the failure of the treatment in this group is attributable to the fact that some people are more readily hypnotized than others. Indeed, brain imaging studies suggest that the strength of connections to and from the anterior cingulate gyrus differs between hypnotizable and non-hypnotizable individuals (Cojan et al., 2015); this brain region is involved in both hypnosis *and* the perception of pain (see Module 4.4). In addition, to truly understand pain control, researchers must distinguish among different types of pain. Research has shown that hypnosis generally works as well as drug treatments for *acute pain*, which is the intense, temporary pain associated with a medical or dental procedure (Patterson & Jenson, 2003). The effect of hypnosis on chronic pain is more complicated, as some conditions are due to purely physical causes whereas others are more psychological in nature. For these latter conditions, it is likely that the patient will expect to continue to feel pain regardless of the treatment, thus reducing the effectiveness of hypnosis.

Under hypnosis, people can withstand higher levels of pain for longer periods of time, including the discomfort associated with dental procedures.

Bikeriderlondon/Shutterstock

Myths in Mind

Recovering Lost Memories through Hypnosis

Before the limitations of hypnosis were fully understood, professionals working in the fields of psychology and law regularly used this technique for uncovering lost memories. What a powerful tool this would be for a psychologist—if a patient could remember specifics about trauma or abuse it *could* greatly help the individual's recovery. Similarly, law enforcement and legal professionals could benefit by learning the details of a crime recovered through hypnosis—or so many assumed.

However, as you have read, hypnosis puts the subject into a highly suggestible state. This condition leaves the individual vulnerable to prompts and suggestions by the hypnotist. A cooperative person could certainly comply with suggestions and create a story that, in the end, was entirely false. This has happened time and again. In reality, hypnosis does not improve memory (Kihlstrom, 1997; Loftus & Davis, 2006). Today, responsible psychologists do not use hypnotherapy to uncover or reconstruct lost memories. Police officers have also largely given up this practice. In 2007, the Supreme Court of Canada ruled that testimony based on hypnosis sessions alone cannot be submitted as evidence (Supreme Court of Canada, 2007).

Mind-Wandering

Listen to the Audio

During hypnosis, an individual enters an altered state of consciousness in which he or she is more suggestible than at other times. Although the idea of altered states of consciousness might seem strange to you at first, you actually experience them all the time, possibly even while reading this book. One such example is mind-wandering, an obstacle to your (and everyone else's) ability to work and study.

What Is Mind-Wandering?

Listen to the Audio

Imagine sitting in a large lecture hall listening to an enthusiastic professor talk about European history. Despite the fascinating topic filled with battles and revolutions, after a few minutes, you start to think about a conversation you had with a friend the day before. Then you start to think about the witty remarks you wish you had made, and fantasize about unleashing these comments on people in an argument sometime in the future. Then, suddenly, you are back in your classroom, and see an unfamiliar slide on the screen at the front of the room. Your body was physically present in the classroom for the entire lecture, but your mind was elsewhere. This is an example of **mind-wandering**, *an unintentional redirection of attention from the current task to an unrelated train of thought* (Mooneyham & Schooler, 2013).

The frequency with which we think about something unrelated to what we are doing is astonishing. This was powerfully demonstrated in an innovative study in which researchers programmed an iPhone app that contacted participants at random times during the day (Killingsworth & Gilbert, 2010). Participants were asked, “Are you thinking about something other than what you're currently doing?” The results indicated that mind-wandering occurred in 47% of the samples taken. The frequency of mind-wandering was over 30% for every activity other than sex! The challenge for psychologists is to determine whether—or how much—these lapses of attention affect our ability to work and study.

At first glance, studying the effects of mind-wandering might seem impossible—how you do study the process of *not* paying attention? However, in the past decade, psychologists have conducted a number of studies examining how mind-wandering affects attention and memory (e.g., Kam & Handy, 2014). For instance, several studies have shown that mind-wandering decreases reading comprehension. In one such study conducted at the University of Alberta, participants read either an engaging passage (an excerpt from Anne Rice's *Interview with the Vampire*) or a less interesting passage (an excerpt from William M. Thackeray's *The History of Pendennis*). While reading the assigned passages, participants were occasionally asked whether they were attending to the text. Not surprisingly, the researchers found that for both types of passages, the recall of the material was better when participants were paying attention to the text rather than mind-wandering (Dixon & Bortolussi, 2013). However, the errors caused by mind-wandering went beyond missing minor details. Participants in this and other experiments often missed major elements of the plot. One study found that mind-wandering participants couldn't identify the villain in a mystery story (Smallwood et al., 2008)! Given these results, it should come as no surprise that mind-wandering is associated with poorer retention of university lecture material (Risko et al., 2012) and with poorer scores on intelligence tests (Mrazek et al., 2012).

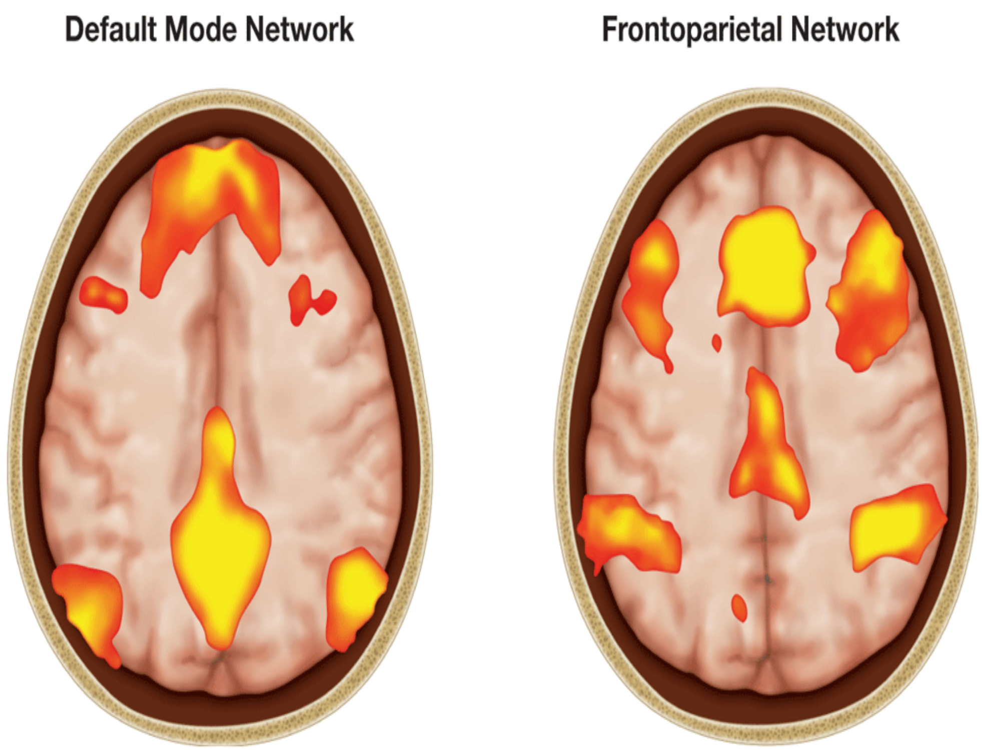
Of course, if we spend at least 30% of our time not consciously attending to our current situation, it does make you wonder where your mind wandered off to. Recent brain imaging studies suggest an interesting destination.

Mind-Wandering and the Brain

Listen to the Audio

In the late 1990s, Marcus Raichle and his research team made a discovery that would change psychology. While looking at their brain imaging data, Raichle noticed that a number of brain areas were active. For most scientists, finding brain activity that is consistent with your predictions is a cause for celebration, if not a trip to the campus pub. But Raichle noticed something else in his data. He noticed that across a number of studies, the same pattern of *de*activations also occurred (Raichle et al., 2001). In other words, a network of brain regions became *less* active when participants performed a task (see Figure 5.9). This network, now known as the **default mode network**, *is a network of brain regions including the medial prefrontal cortex, posterior cingulate gyrus, and medial and lateral regions of the parietal lobe that is most active when an individual is awake but* not *responding to external stimuli*. In other words, the default mode network is more active when a person is paying attention to his internal thoughts rather than to an outside stimulus or task (Raichle, 2015).

Figure 5.9 The Default Mode Network and Frontoparietal Network



The default mode network (left) is involved with self-related thinking. The frontoparietal network is linked with goal-directed thought and planning. Both are involved with mind-wandering.

The default mode network also appears to be related to mind-wandering; this makes sense given that mind-wandering is often associated with becoming lost in one's own thoughts (Gruberger et al., 2011). In one fMRI study conducted at the University of British Columbia, researchers measured participants' brain activity while they performed a simple (and boring) perceptual task. At different points in the experiment, participants were asked (1) "Where was your attention focused just before the probe [the question]?" and (2) "How aware were you of where your attention was focused?" Activity in the default mode network was more pronounced when participants were not paying attention to the perceptual task. This effect was largest when they weren't aware that they were mind-wandering (Christoff et al., 2009). Importantly, the default

mode network wasn't the only group of brain areas found to be active during mind-wandering. A network involving parts of the frontal and parietal lobes also showed increased activity when mind-wandering was occurring (Fox et al., 2015). This *frontoparietal network* is associated with goal-directed thinking such as planning for the future, as well as the control of attention (i.e., "executive functioning"). This pattern of activity is important—the fact that a brain network involved in higher-order thought shows stronger connectivity during mind-wandering suggests that these lapses of attention might actually serve a useful purpose.

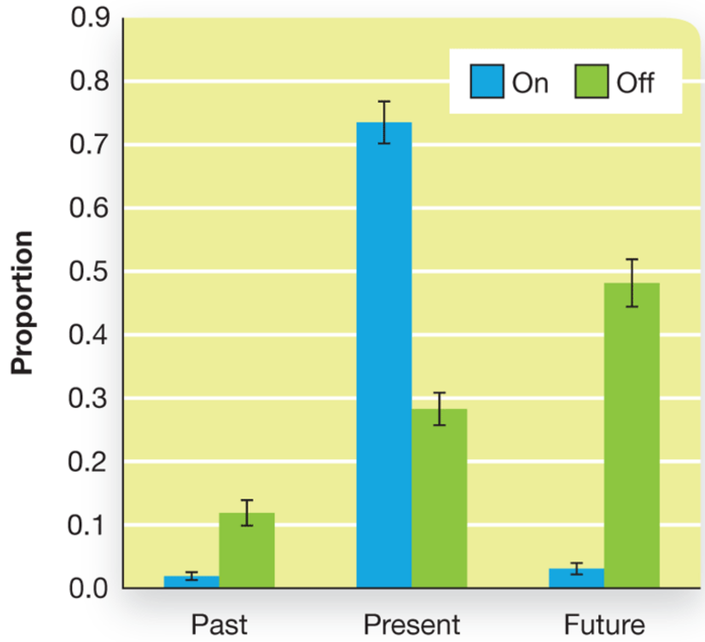
The Benefits of Mind-Wandering

Listen to the Audio

Our minds don't always wander. If you're being chased by a bear, it's unlikely that you'll start daydreaming about your cute classmate. Instead, mind-wandering typically occurs during tasks that are repetitive, don't require much thought, and/or that we've experienced before. If we're not dedicating many mental resources to a given task, we will have more resources to dedicate to mind-wandering (Risko et al., 2012).

It is at this point that the increased activity in the frontal and parietal brain areas becomes important. One function of the frontal lobes is planning future goals and actions. As it turns out, mind-wandering is related to future thinking (Smallwood et al., 2011). In one study, participants completed a simple reaction-time task; at various points in the experiment, they were interrupted and asked what they were thinking about. The experimenters then judged whether the participants' thoughts were focused on the past, the present, or the future. When participants were thinking about the experimental task, their thoughts were (not surprisingly) rated as being focused on the present most of the time (see Figure 5.10). In contrast, when people were mind-wandering, there was a strong tendency to be thinking about the future. This future focus may allow us to think about possible plans of action before we are actually in that situation, an ability that could be quite useful (Baird et al., 2011).

Figure 5.10 Mind-Wandering about the Future



When participants are paying attention to the task (“On”), their thoughts were judged to be focused on the present situation. When they were mind-wandering (“Off,” for “off-task”), they were more likely to be thinking about the future.

Source: Republished with permission of Elsevier Science, Inc., from Back to the future: Autobiographical planning and the functionality of mind-wandering. *Consciousness and Cognition 20*, 1604-1611, 2011, Benjamin Baird; Jonathan Smallwood; Jonathan W. Schooler. Permission conveyed through Copyright Clearance Center, Inc.

It is important to note that although some studies have shown benefits to mind-wandering, this area of research is still in its initial stages. All researchers would agree that your performance on most tasks would be improved if they received your full conscious attention. Unfortunately, as you will read in the next section, this is not always possible.

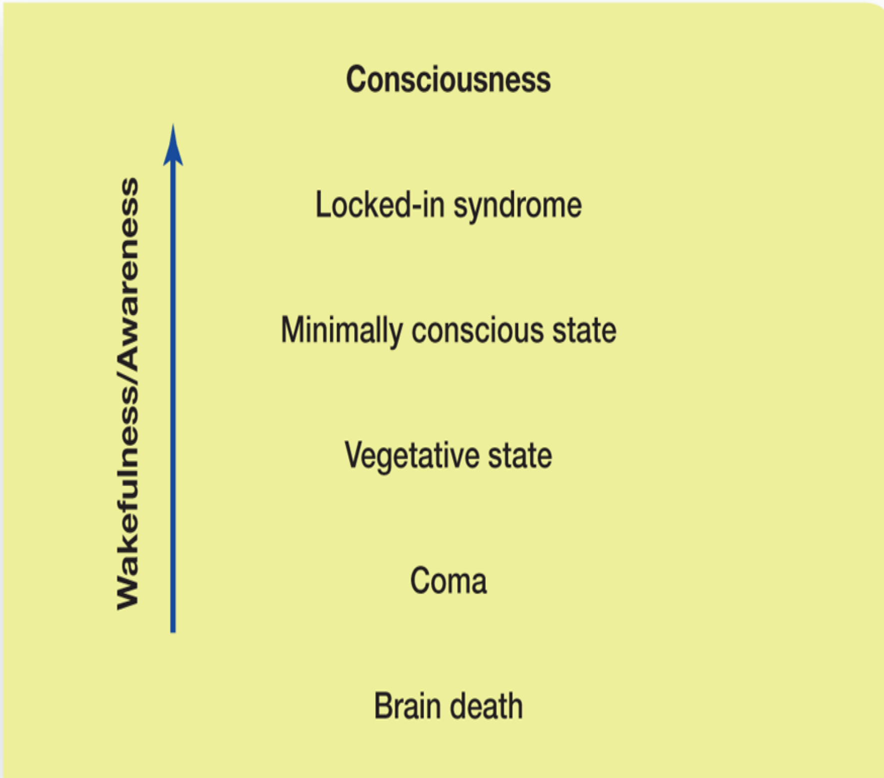
Disorders of Consciousness

Listen to the Audio

In 1990, a Florida woman named Terri Schiavo collapsed to the ground. She had suffered a full cardiac arrest, resulting in massive brain damage due to a lack of oxygen. She would never regain consciousness. After she had been in a coma for almost three months, her diagnosis was changed to a persistent vegetative state. In 1998, her husband asked the hospital to remove her feeding tube because he was sure she wouldn't want to live this way. Her parents fought the decision, claiming part of Terri was still conscious. The ethical and legal battles continued for seven years, and included President George W. Bush cutting his vacation short in order to return to Washington to sign a legal order keeping her alive (Cranford, 2005). Eventually, after the U.S. Supreme Court refused to hear an appeal, her feeding tube was removed for the last time. Terri Schiavo died on March 31, 2005.

The Terri Schiavo case highlights the importance of consciousness in medical decision making. Consciousness can take many forms, all of which vary in terms of how aware a person is of their environment. In patients with brain damage, the degree to which a patient is conscious of their surroundings can influence the diagnosis that they receive (Lee et al., 2015). Neurologists distinguish six types of consciousness, ranging from little-to-no brain function up to normal levels of awareness (see Figure 5.11).

Figure 5.11 Disorders of Consciousness

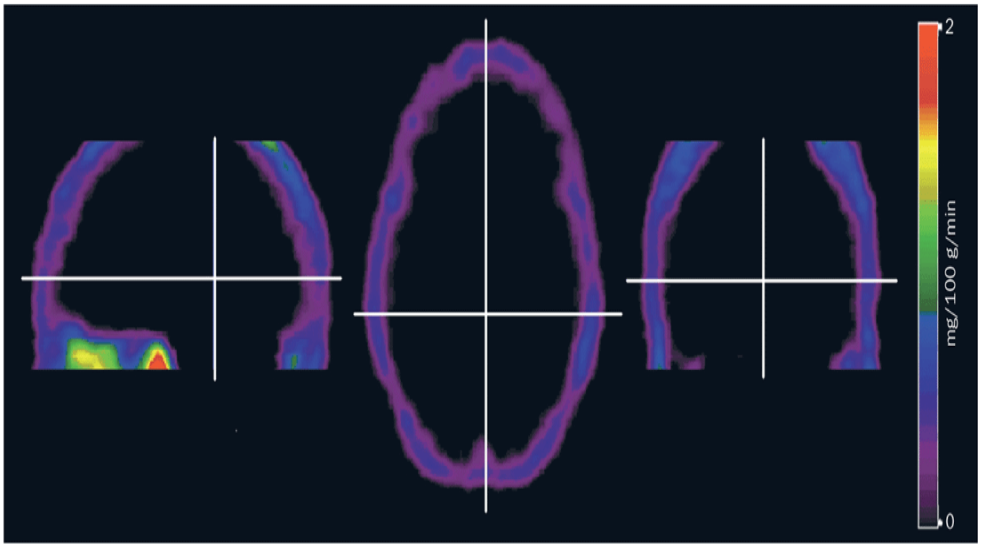


Although more nuanced diagnoses exist, this diagram depicts six key levels of consciousness used in the diagnosis of brain-damaged individuals.

Source: Gawryluk, J. R., D'Arcy, R. C. N., Connolly, J. F., & Weaver, D. F. (2010). Improving the clinical assessment of consciousness with advances in electrophysiological and neuroimaging techniques. *BMC Neurology*, *10*, 11. Fig. 1, p. 3.

The lowest level of consciousness in a person who is still technically alive is known as **brain death**, *a condition in which the brain, specifically including the brainstem, no longer functions* (American Academy of Neurology, 1995). Individuals who are brain dead have no hope of recovery because the brainstem regions responsible for basic life functions like breathing and maintaining the heartbeat do not function (see Figure 5.12).

Figure 5.12



This positron emission tomography (PET) scan shows the amount of glucose being used by the brain. In a healthy brain, most of the image would be yellow, green, or red, indicating activity. Here, only the tissue surrounding the brain is using glucose, giving the image the appearance of being an empty skull; functionally speaking, it is one.

Source: Laureys, S., Owen, A. M., & Schiff, N. D. (2004). Brain function in brain death, coma, vegetative state, and related disorders. *Lancet Neurology*, *3*, 537–546. Fig. 3, p. 539.

In contrast to brain death, a **coma** *is a state marked by a complete loss of consciousness*. It is generally due to damage to the brainstem or to widespread damage to both hemispheres of the brain (Bateman, 2001). Patients who are in a coma have an absence of both wakefulness and awareness of themselves or their surroundings (Gawryluk et al., 2010). Some of the patient's brainstem reflexes will be suppressed, including pupil dilation and constriction in response to changes in brightness. Typically, patients who survive this stage begin to recover to higher levels of consciousness within 2–4 weeks, although there is no guarantee that the patient will make a full recovery.

If a patient in a coma improves slightly, the individual may enter a **persistent vegetative state**, *a state of minimal to no consciousness in which*

the patient's eyes may be open, and the individual will develop sleep–wake cycles without clear signs of consciousness. For example, vegetative state patients do not appear to focus on objects in their visual field, nor do they track movement. These patients generally do not have damage to the brainstem. Instead, they have extensive brain damage to the grey matter and white matter of both hemispheres, leading to impairments of most functions (Laureys et al., 2004; Owen & Coleman, 2008). The likelihood of recovery from a vegetative state is time dependent. If a patient emerges from this state within the first few months, they could regain some form of consciousness. In contrast, if symptoms do not improve after three months, the patient is classified as being in a *permanent vegetative state;* the chances of recovery from that diagnosis decrease sharply (Wijdicks, 2006). Although recent nerve-stimulation studies show promise in helping these patients improve slightly (Corazzol et al., 2017), it is still unlikely that most patients in permanent vegetative states will regain consciousness.

Thus far, we have discussed disorders of consciousness as though there were a quick-and-easy tool for diagnoses. While this is definitely true for brain death, distinguishing between other conditions is much more difficult. In fact, misdiagnosis of these disorders is estimated to be as high as 43% (Gawryluk et al., 2010; Schnakers et al., 2009). The challenge, therefore, is to develop or adapt tools that will help neurologists more accurately diagnose these mysterious conditions.

There are two other disorders of consciousness that are often diagnosed by neurologists. One is the **minimally conscious state (MCS)**, *a disordered state of consciousness marked by the ability to show some behaviours that suggest at least partial consciousness, even if on an inconsistent basis*. A minimally conscious patient must show *some* awareness of themself or their environment, and be able to reproduce this behaviour. Examples of some behaviours that are tested are following simple commands, making

gestures or yes/no responses to questions, and producing movements or emotional reactions in response to some person or object in their environment. When neuroimaging is used, minimally conscious patients show more activity than vegetative patients, including activity in some higher-order sensory and cognitive regions (Boly et al., 2004).

The disorder of consciousness that most resembles the healthy, awake state—at least in terms of awareness—is **locked-in syndrome**, *a disorder in which the patient is aware and awake but, because of an inability to move his or her body, appears unconscious* (Smith & Delargy, 2005). Locked-in syndrome was brought to the attention of most people by the movie *The Diving Bell and the Butterfly*, which depicted Jean-Dominique Bauby's attempts to communicate to the outside world using eye movements. This disorder is caused by damage to part of the pons, the region of the brainstem that sticks out like an Adam's apple. Most patients with locked-in syndrome remain paralyzed. Luckily, new technology is making it easier for these patients to communicate with the outside world.

The final stage of consciousness is the healthy, conscious brain. That's you. Be grateful.

Types of Disorders of Consciousness Review

Study the table. Then, select "Check Your Understanding" to test your knowledge.

Definition	Term
a condition in which the brain, specifically including the brainstem, no longer functions	brain death
a state marked by a complete loss of consciousness	coma
a disordered state of consciousness marked by the ability to show some behaviours that suggest at least partial consciousness, even if on an inconsistent basis	minimally conscious state (MCS)
a disorder in which the patient is aware and awake but, because of an inability to move his or her body, appears unconscious	locked-in syndrome
a state of minimal to no consciousness in which the patient's eyes may be open, and the individual will develop sleep–wake cycles without clear signs of consciousness	persistent vegetative state

Check Your Understanding

Working the Scientific Literacy Model

Assessing Consciousness in the Vegetative State

Determining a brain-damaged patient's level of consciousness is quite challenging. It also has important implications for the patient's treatment. If they are shown to have some degree of awareness of the situation and/or their environment, then it seems reasonable to get the patient's opinion on matters affecting treatment. In contrast, if they are unresponsive, then such decisions should be made entirely by the family and the medical team. Everyone wants what is best for the patient, but the tools used to assess consciousness are still a work in progress.

What do we know about the assessment of consciousness in vegetative patients?

The initial assessment of consciousness in severely brain-damaged patients is generally performed at the patient's bedside. Doctors will perform tests of a patient's reflexes (e.g., pupil responses, which involve the brainstem) and examine other simple responses. The most common assessment tool is the Glasgow Coma Scale (GCS), a 15-item checklist for the physician. The GCS measures eye movements—whether they can open at all, open in response to pain, open in response to speech, or open spontaneously without any reason. The next five items on this checklist assess language abilities (e.g., do they use incorrect words?). The final six items measure movement abilities such as whether the patient responds to pain and whether they can obey commands. Scores of 9 or below reflect a severe disturbance of consciousness. (For comparison, individuals suffering from a

concussion tend to score between 13 and 15, which is labelled as a mild disturbance.)

Checklists such as the GCS provide a useful initial indicator of a brain-damaged patient's abilities. However, many of the behaviours measured by this and similar assessment tools focus more on overt behaviours (i.e., movements) than on indirect indications of awareness. A patient's inability to move may imply a greater disturbance of consciousness than actually exists, thus leading to potential misdiagnoses. Improvements in brain imaging techniques may prove to be a more sensitive tool for investigating consciousness.

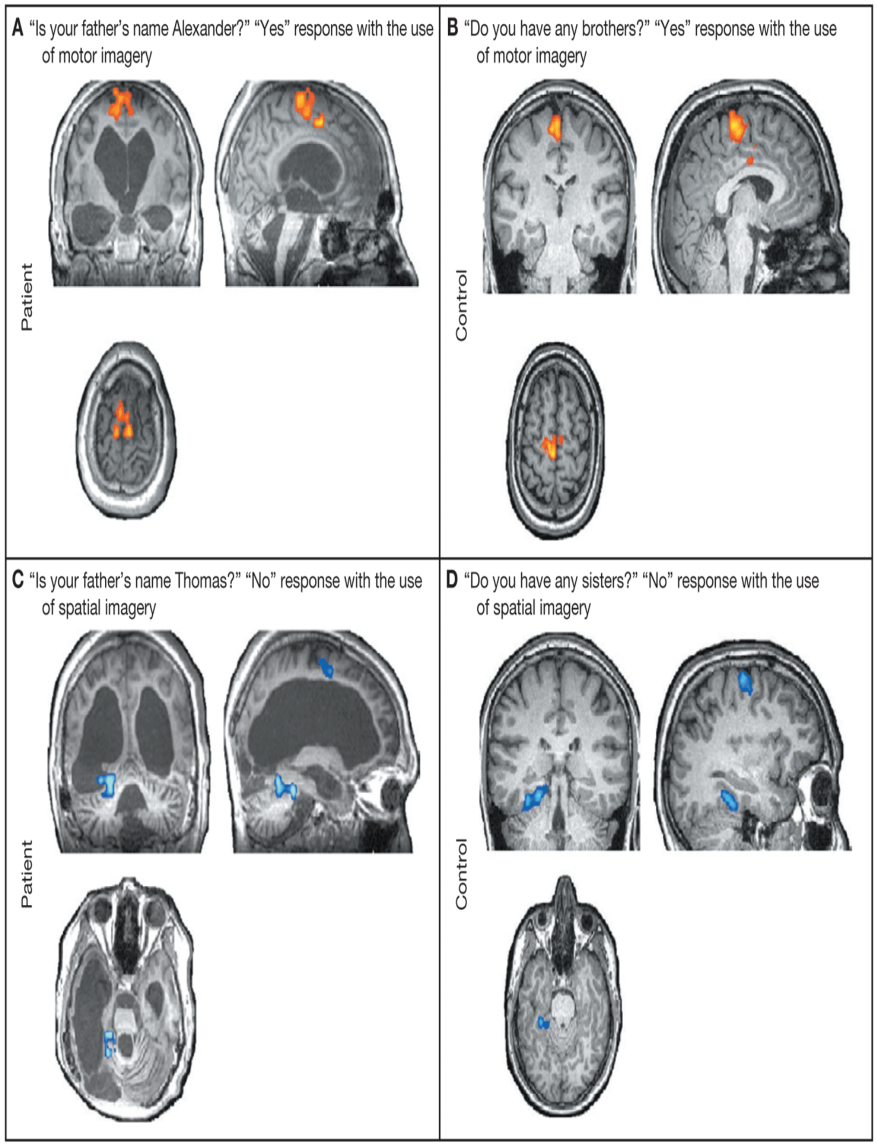
How can science explain consciousness in vegetative patients?

Researchers have argued for some time that *some* patients in a persistent vegetative state can show *some* signs of consciousness. For example, some patients have shown rudimentary responses to language. There have been cases of neurological changes in response to one's name (Staffen et al., 2006), as well as the emotional tone of a speaker's voice (Kotchoubey et al., 2009). However, the most stunning example of consciousness in this patient group was shown by Adrian Owen (now at Western University) and his colleagues (Owen et al., 2006). In their study, a 23-year-old patient in a vegetative state was asked to perform two different mental imagery tasks during an fMRI scan. In one task, she was asked to imagine playing tennis, an activity involving a specific set of movements. In the other task, she was asked to imagine visiting all of the rooms in her house, starting at the front door (this required her to develop a spatial map of her house). Despite not being able to respond to any questions verbally, this patient's brain showed clear evidence of understanding the commands. Imagining playing tennis activated

brain areas related to movement; imagining walking through her house activated a spatial network, including the parahippocampal gyrus and the parietal lobe. This result provided stunning evidence that the patient did, in fact, have some degree of consciousness.

Owen and his colleagues have performed several subsequent studies with larger groups of patients (Owen, 2013). However, not all patients are able to modify their own brain activity. In a study including 54 patients, only five were able to perform the tennis–house task (Monti et al., 2010). But, one of these patients was able to do something remarkable: He was able to learn to use the tennis–house imagery task to communicate! The experimenters asked him simple questions and told him to imagine playing tennis if he wanted to respond "yes" and to imagine walking through his house if he wanted to respond "no" (see Figure 5.13). Using this technique, he was able to demonstrate that some of his cognitive abilities were preserved. Of course, we must be cautious and remember that this is only one patient among dozens who were tested. The ongoing challenge for researchers is to determine what made the five "fMRI responders" different from the 49 non- responders, and to use that information to help identify other patients who might still retain some degree of consciousness.

Figure 5.13 Using fMRI to Communicate with a Vegetative Patient



Results of two sample communication scans obtained from Patient 23 (Panels A and C) and a healthy control subject (Panels B and D) during functional MRI are shown. In Panels A and B, the observed activity pattern (orange) was very similar to that observed in the motor-imagery localizer scan (i.e., activity in the supplementary motor area alone), indicating a "yes" response. In Panels C and D, the observed activity pattern (blue) was very similar to that observed in the spatial-imagery localizer scan (i.e., activity in both the parahippocampal gyrus and the supplementary motor area), indicating a "no" response. The names used in the questions have been changed to protect the privacy of the patient.

Source: Monti, M. M., et al. (2010). Willful modulation of brain activity in disorders of consciousness. *New England Journal of Medicine, 362*(7), 587. Fig. 3 (communication scans).

Can we critically evaluate this evidence?

The initial neuroimaging studies of consciousness in vegetative state patients are indeed promising. However, there are some important issues that need to be dealt with. First, we mentioned above that up to 43% of patients with disorders of consciousness are misdiagnosed. Given that a small subset of the vegetative state patients were able to modify their brain activity, it is possible that they were not actually in a vegetative state, but instead had a less severe condition. Second, the researchers are equating language abilities with consciousness; yet, consciousness could take the form of responses to other, non-linguistic stimuli (Overgaard & Overgaard, 2011). This criticism would be particularly important if a vegetative state patient had damage to brain areas related to language comprehension.

We also have to be cautious about the use of PET and fMRI scans in patients with widespread brain damage. Both types of neuroimaging measure characteristics of blood flow in the brain. But damage to the brain will alter how the blood flows (Rossini et al., 2004); therefore, we need to be careful when comparing patients with healthy controls. One way around this latter concern is to use multiple methods of neuroimaging (Gawryluk et al., 2010). Increasing numbers of research groups are using EEG, which measures neural activity using electrodes attached to the scalp, to search for brain function in vegetative patients (Cruse et al., 2011; Wijnen et al., 2007). Given that distinct brain waves have been identified for sensory detection of a stimulus, the detection of unexpected auditory stimuli, higher-level analysis of stimuli, and semantic (meaning) analysis of language, this

technology could provide important insights into the inner worlds of vegetative state patients. Indeed, Canadian researchers have developed the EEG-based Halifax Consciousness Scanner for this specific purpose (Sculthorpe-Petley et al., 2015).

Why is this relevant?

Neuroimaging investigations of consciousness in vegetative state patients could literally have life-and-death implications. Currently, doctors have a very difficult time determining a patient's level of consciousness if they cannot move or make some sort of response. However, this information influences the decision about whether to remove that patient from life support. If brain imaging could provide insight into the inner world of patients (or, in some cases, lack thereof), it would provide doctors and family members with valuable information that would help them make the right decision for the patient.

Module 5.2 Summary

Listen to the Audio

5.2a Know . . . the key terminology associated with hypnosis, mind-wandering, and disorders of consciousness.

Review Module 5.2

Start Over Swap

0/10 REVIEWED · 0 MASTERED

minimally conscious state (MCS)

Previous Next Got It!

5.2b Understand . . . the competing theories of hypnosis.

Dissociation theory states that hypnosis involves a division between a lower-level system involved with perception and movement and an “executive” system that evaluates and monitors these behaviours. In contrast, the social-cognitive theory states that a person’s beliefs and

expectations about hypnosis heighten his or her willingness to follow suggestions.

5.2c Apply . . . your knowledge of hypnosis to identify what it can and cannot do.

Apply Activity

Hypnosis could potentially work in the following scenarios (answer true or false):

6 questions

1. Temporarily increasing physical strength

- True
- False

Next

5.2d Analyze . . . the effectiveness of using neuroimaging to study mind-wandering.

Neuroimaging studies have repeatedly shown that two brain networks—the default mode network and the frontoparietal network—are more active when someone is mind-wandering. However, it is important to remember that brain imaging studies are correlational in nature. The activity in these networks *co-occurs* with mind-wandering, but we cannot say for certain if this activity *causes* mind-wandering.

5.2e Analyze . . . the ability of researchers to detect consciousness in brain-damaged patients.

Consciousness is difficult to detect using traditional bedside testing because many of these testing tools require movement. Using neuroimaging (specifically fMRI), it has been possible to detect conscious awareness in some patients who are in a vegetative state, as well as in patients who are in a minimally conscious state and those with locked-in syndrome. Although these studies do have some limitations (discussed earlier in this module), the results show that it is an exciting time for neuroscience research in Canada!

Module 5.3 Drugs and Conscious Experience

Listen to the Audio

Nathan Griffith/Alamy Stock Photo

Learning Objectives

5.3a Know . . . the key terminology related to different categories of drugs and their effects on the nervous system and behaviour.

5.3b Understand . . . drug tolerance and dependence.

5.3c Apply . . . your knowledge to better understand your own beliefs about drug use.

5.3d Analyze . . . the difference between spiritual and recreational drug use.

5.3e Analyze . . . the short- and long-term effects of drug use.

Could taking a drug-induced trip be a way to cope with traumatic stress or a life-threatening illness? A variety of medications for reducing anxiety or alleviating depression are readily available. However, a few doctors and psychologists have suggested that perhaps a six-hour trip on psychedelic "magic" mushrooms (called psilocybin) could be helpful to people dealing with difficult psychological and life problems. (It would also help them communicate with the sparkling trilingual dragon sighing in the bathtub.)

In the 1960s, a fringe group of psychologists insisted that psychedelic drugs were the answer to all the world's problems. The outcast nature of this group and the ongoing "war on drugs" prompted mainstream psychologists to shelve any ideas that a psychedelic drug or something similar could be used in a therapeutic setting. However, this perception appears to be changing. Recently, Roland Griffiths from Johns Hopkins University in Maryland has been conducting studies on the possible therapeutic benefits of psilocybin mushrooms. Cancer patients who were experiencing depression volunteered to take psilocybin as a part of

Dr. Griffiths's study. Both at the end of their experience and 14 months later, they reported having personally meaningful, spiritually significant experiences that improved their overall outlook on life (Griffiths et al., 2008). Subsequent studies have shown that psilocybin mushrooms can help reduce the symptoms of tobacco addiction (Johnson et al., 2014), and may even increase openness of one's personality (MacLean et al., 2011). Although these findings are not likely to convince your doctor to give you a bag of magic mushrooms, they do illustrate an important point: most drugs can be used to alter brain chemistry for both medical and recreational purposes. The line between "medicine" and "drug" is a blurry one indeed.

Every human culture uses drugs. It could even be argued that every *human* uses drugs, depending on your definition of the term. Many of the foods that we eat contain the same types of compounds found in mind-altering drugs. For example, nutmeg contains compounds similar to those found in some psychedelic substances, and chocolate contains small amounts of the same compounds found in amphetamines and marijuana (Wenk, 2010). Of course, caffeine and alcohol—both of which are mainstream parts of our culture—are also drugs. The difference between a drug and a non-drug compound seems to be that drugs are taken because the user has an intended effect in mind. Regardless of why we use them, drugs influence the activity of some elements of our central nervous system, affecting us both physically and psychologically. In this module, we will discuss these physical and psychological effects of drug use. We will then examine how these processes are affected by different classes of drugs.

Physical and Psychological Effects of Drugs

Listen to the Audio

Although we often think of drugs as having a simple effect such as relieving pain or “getting someone high,” the reality is actually much more complicated. To truly understand the impact of a drug on how people act and feel, we have to look at both the short-term and the long-term effects of drugs.

Short-Term Effects

Listen to the Audio

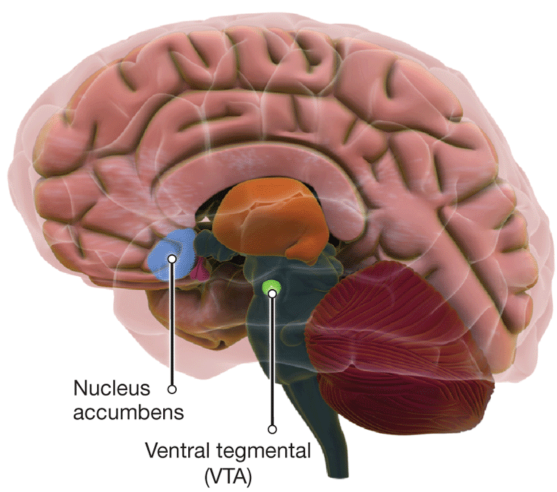
Your brain contains a number of chemical messengers called neurotransmitters (see Module 3.2). These brain chemicals are released by a neuron (the pre-synaptic neuron) into the synapse, the space between the cells. They then bind to receptors on the surface of other neurons (the post-synaptic neurons), thus making these neurons more or less likely to fire. Drugs influence the amount of activity occurring in the synapse. Thus, they can serve as an *agonist* (which enhances or mimics the activity of a neurotransmitter) or an *antagonist* (which blocks or inhibits the activity of a neurotransmitter).

The short-term effects of drugs can be caused by a number of brain mechanisms, including (1) altering the amount of the neurotransmitter being released into the synapse, (2) preventing the reuptake (i.e., reabsorption back into the cell that released it) of the neurotransmitter once it has been released, thereby allowing it to have a longer influence on other neurons, (3) blocking the receptor that the neurotransmitter would normally bind to, or (4) binding to the receptor in place of the neurotransmitter. In all of these scenarios, the likelihood of the postsynaptic neurons firing is changed, resulting in changes to how we think, act, and feel.

Different drugs will influence different neurotransmitter systems. For instance, the "club drug" ecstasy primarily affects serotonin levels, whereas painkillers like OxyContin™ affect opioid receptors. However,

the brain chemical that is most often influenced by drugs is dopamine, a neurotransmitter involved with the rewarding, pleasurable feelings associated with many drugs (Volkow et al., 2009). Dopamine release in two brain areas, the *nucleus accumbens* and the *ventral tegmental area*, is likely related to the "high" associated with many drugs (Koob, 1992; see Figure 5.14). These positive feelings serve an important, and potentially dangerous, function: They reinforce the drug-taking behaviour. In fact, the dopamine release in response to many drugs makes them more rewarding than sex or delicious food (Bassareo & Di Chiara, 1999; Di Chiara & Imperato, 1988; Fiorino et al., 1997). This reinforcing effect is so powerful that, for someone who has experience with a particular drug, even the *anticipation* of taking the drug is pleasurable and involves the release of dopamine (Schultz, 2000).

Figure 5.14 Brain Regions Associated with the Effects of Drugs



The nucleus accumbens and ventral tegmental area are associated with reward responses to many different drugs.

But, the drug–neurotransmitter relationship is not as simple as it would seem. This is because the effects of drugs involve biological, psychological, and social mechanisms. Think about the effects of alcohol.

Drinking half a bottle of wine at a party often leads people to be more outgoing, whereas drinking half a bottle at home might cause them to fall asleep on the couch. In each case, the drug was the same: alcohol. But the effects of the drug differed because the situations in which the drug was consumed changed. The setting in which drugs are consumed can also have a more sinister effect: Overdoses of some drugs are more common when they are taken in new environments than when they are taken in a setting that the person often uses for drug consumption (Siegel et al., 1982). When people enter an environment that is associated with drug use, their bodies prepare to metabolize drugs even before they are consumed (i.e., their bodies become braced for the drug's effects). Similar preparations do not occur in new environments, which leads to larger, and potentially fatal, drug effects (see Module 6.1). Another psychological factor that influences drug effects is the person's experience with a drug. It takes time for people to learn to associate taking the drug with the drug's effects on the body and brain. Therefore, a drug might have a much more potent effect on a person the third or fourth time they took it than it did the first time, which is very common with some drugs, such as marijuana. Finally, a person's expectations about the drug can dramatically influence its effects. If a person believes that alcohol will make them less shy, then it is likely that a few glasses of wine will have that effect.

How can we reconcile these psychological effects with the physiological effects just discussed? To do so, we have to remember that the psychological states mentioned also influence the activity of brain areas. For instance, dealing with novel or stressful situations (e.g., being surrounded by strangers, or your parents arriving home early) often requires input from the frontal lobes; this activity might reduce the impact that drugs are having on a person's behaviour. A similar result can occur when a person has expectations about a drug. This mental set can itself change the activity of different brain areas and can alter the effects

of a drug. Thus, the effects of drugs are yet another example of how our biology and psychology interact to create our conscious experiences.

Long-Term Effects

Listen to the Audio

Importantly, the effects that different drugs will have on us change as we become frequent users. Think about a drug that most of you use: caffeine (found in coffee, tea, some soft drinks, and those energy drinks that come in a tall can that would make Freud raise his eyebrows). The first time you had a cup of coffee, you were likely wired and unable to sleep. But veteran coffee drinkers rarely experience such a large burst of energy; some can even drink coffee before going to bed. This is an example of **tolerance**, *when repeated use of a drug results in a need for a higher dose to get the intended effect*. While tolerance might seem annoying, it is actually the brain's attempt to keep the level of neurotransmitters at stable levels. When receptors are overstimulated by neurotransmitters, as often happens during drug use, the neurons fire at a higher rate than normal. In order to counteract this effect and return the firing rate to normal, some of the receptors move farther away from the synapse so that they are more difficult to stimulate, a process known as *down-regulation*.

Tolerance is not the only effect that can result from long-term use of legal or illegal drugs. Another is **physical dependence**, *the need to take a drug to ward off unpleasant physical withdrawal symptoms*. The characteristics of dependence and withdrawal symptoms differ from drug to drug. Caffeine withdrawal can involve head and muscle aches and impaired concentration. Withdrawal from long-term alcohol abuse is much more serious. A person who is dependent on alcohol can experience extremely severe, even life-threatening, withdrawal symptoms including nausea,

increased heart rate and blood pressure, and hallucinations and delirium. However, drug dependence is not limited to physical symptoms. **Psychological dependence** *occurs when emotional need for a drug develops without any underlying physical dependence*. Many people use drugs in order to ward off negative emotions. When they no longer have this defence mechanism, they experience the negative emotions they have been avoiding, such as stress, depression, shame, or anxiety. Therefore, treatment programs for addiction often include some form of therapy that will allow users to learn to cope with these emotional symptoms while they are attempting to deal with the physical symptoms of withdrawal.

There is no single cause of drug dependence; instead, consistent with the biopsychosocial model, researchers believe that numerous factors influence whether someone will become dependent upon a drug as well as the severity of that dependence. At the biological level, researchers are attempting to identify the specific genes—or groups of genes—that make someone prone to becoming addicted to different drugs (Foroud et al., 2010). For example, the A1 allele of the *DRD2* gene, which influences the activity of dopamine receptors, is related to reward processing and to being open to new experiences (Peciña et al., 2013); it is also more common in people who are addicted to opioid drugs such as heroin (Clarke et al., 2012). In contrast, researchers at the University of Toronto found that a protective version of the *CYP2A6* gene is more common in people who do *not* smoke; this version of the gene is related to feelings of nausea and dizziness occurring when the person is exposed to smoking (Pianezza et al., 1998). Although we cannot go through a complete list of the genes involved with responses to various drugs, these examples show that scientists are rapidly identifying specific genes related to drug-taking behaviour.

However, genes are obviously not the only cause of drug dependence; researchers are also examining cognitive factors affecting drug-taking

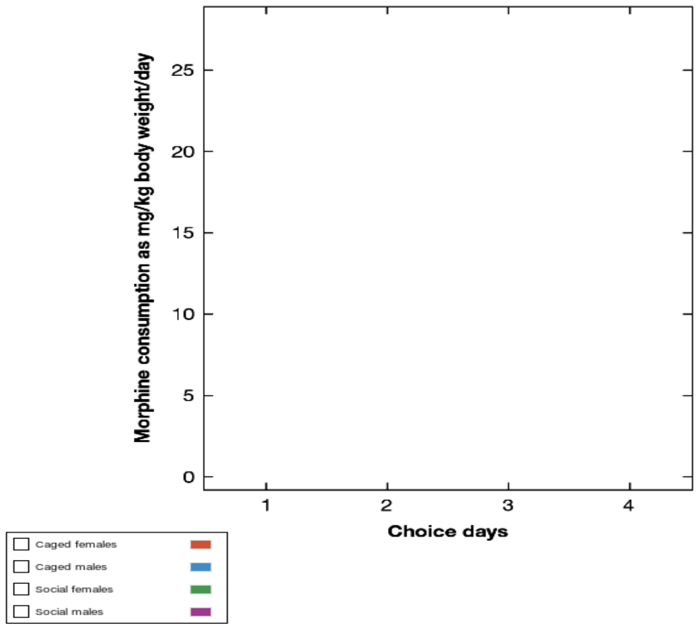
behaviour. For example, dependence is influenced by the fact that drugs are often taken in the same situations, such as a cup of coffee to start your day or alcohol whenever you see particular friends. Eventually, taking the drug becomes linked in your memory to that setting or that group of people. When you next see those people or enter that environment, thoughts of the drug will often resurface, making it more likely that you will use, or at least crave, that drug.

Addiction rates are also affected by social factors, such as the culture in which a person lives. For instance, alcoholism rates are lower in religious and social groups that prohibit drinking even though these groups are genetically similar to the rest of the population (Chentsova-Dutton & Tsai, 2007; Haber & Jacob, 2007). Family attitudes toward drugs is a factor as well, as early experiences with different drugs can shape our attitudes toward them and influence how we consume those drugs later in life (Zucker et al., 2008). If a young person first tries wine in a family setting, it will feel much less like a "cool" part of teenage rebellion than if that person first tried the same drink at a high school house party. That initial introduction can alter how that person views alcohol for years to come.

Drug dependence is also influenced by the social support available. The importance of this factor was powerfully demonstrated in a classic (if imperfect) study by Bruce Alexander and his colleagues at Simon Fraser University in 1978. Research in the 1960s and 1970s had shown that rats housed in small cages would eagerly press a lever in order to receive drugs such as morphine; these studies made it appear as though the chemistry of the drugs made them irresistible. However, another possibility existed: perhaps the drug-seeking behaviour was due to the fact that the rats felt isolated, a feeling that mirrors how many drug addicts report feeling. To test this, the researchers gave caged rats access to morphine in a way similar to previous studies. After several weeks of

drug consumption, the rats were randomly assigned to different conditions: a caged group that remained isolated or a social group that was able to interact with other rats in what became known as Rat Park. When rats from both conditions were later given the opportunity to press a lever to receive morphine, the isolated rats were much more likely to do so than the social rats. This effect was particularly apparent in females (see Figure 5.15). These findings suggest that a key factor in drug dependence is a feeling of isolation.

Figure 5.16 Rat Park



In the Rat Park study, all rats self-administered morphine for several weeks. They were then randomly divided into two conditions. Rats that were able to socialize with other rats showed less drug-seeking behaviour than rats that were housed in isolation. This effect was largest in females.

Source: Republished with permission of Springer Science, from Alexander, B.K., Coambs, R., B, & Hadaway, P.F. (1978). The effect of housing and gender on morphine self-administration in rats. *Psychopharmacology 58*.

Finally, all of these variables interact with a person's personality; individuals with impulsive personality traits are more likely to become addicted to drugs regardless of their early experiences or cultural setting

(Lejuez et al., 2010; Perry & Carroll, 2008). Thus, drug dependence does not have a single, simple cause, but is instead influenced by a number of interacting factors, as would be expected by the biopsychosocial model of behaviour.

Commonly Abused Illegal Drugs

Listen to the Audio

Thus far, we have discussed some of the ways in which drugs can affect our brain and our behaviour. These drugs are categorized based on their effects on the nervous system. Drugs can speed up the nervous system, slow it down, stimulate its pleasure centres, or distort how it processes the world. Table 5.3 provides an overview of some of the better-known drugs.

Table 5.3 The Major Categories of Drugs

Study the table. Then, select "Check Your Understanding" to test your knowledge.

Drugs	Psychological Effects	Chemical Effects	Tolerance	Likelihood of Dependence
Stimulants: caffeine, cocaine, amphetamine, ecstasy	Euphoria, increased energy, lowered inhibitions	Increase dopamine, serotonin, norepinephrine activity	Develops quickly	High
Hallucinogens: LSD, psilocybin, DMT, ketamine	Major distortion of sensory and perceptual experiences; fear, panic, paranoia	Increase serotonin activity; block glutamate receptors	Develops slowly	Very low
Opiates: heroin	Intense euphoria, pain relief	Stimulate endorphin receptors	Develops quickly	Very high
Sedatives: barbiturates, benzodiazepines	Drowsiness, relaxation, sleep	Increase GABA activity	Develops quickly	High
		Primarily facilitates GABA		

Check Your Understanding

Almost all of the drugs discussed in this chapter are known as **psychoactive drugs**, *substances that affect thinking, behaviour, perception, and emotion*. However, not all of them are legal. As you will see, the boundary between illicit recreational drugs and legal prescription drugs can be razor-thin at times. Many common prescription medications are chemically similar, albeit safer, versions of illicit drugs; additionally, many legal prescription drugs are purchased illegally and used in ways not intended by the manufacturer.

Stimulants

Listen to the Audio

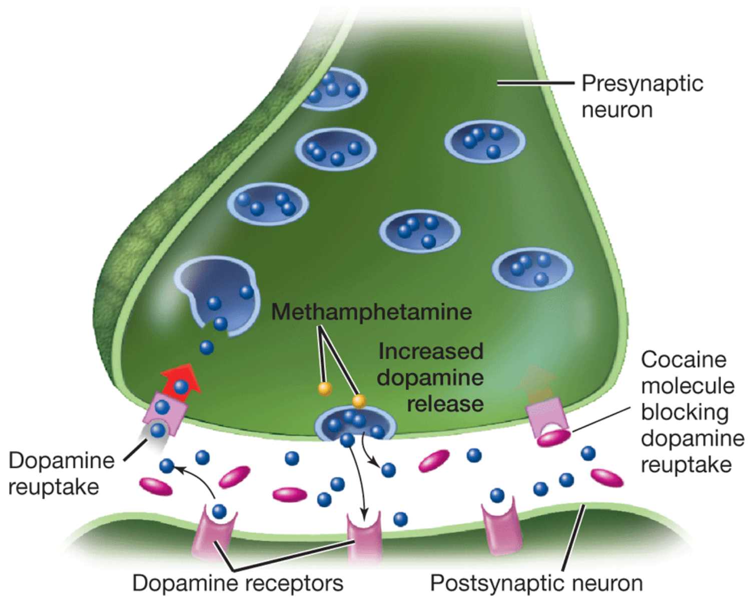
Stimulants *are a category of drugs that speed up the activity of the nervous system, typically enhancing wakefulness and alertness*. There are a number of types of stimulant drugs, ranging from naturally occurring substances such as leaves (cocaine) and beans (coffee) to drugs produced in a laboratory (crystal meth). Additionally, each drug has its own unique effect on the nervous system, influencing the levels of specific neurotransmitters in one of the four ways discussed earlier in this module.

The most widely used—and perhaps abused—stimulant is one that is likely in front of you as you read this: caffeine. Caffeine is obviously not illegal; however, because its neural mechanisms are similar to other stimulants, we will discuss it here. Caffeine can be found in many substances, including coffee, tea, many soft drinks, and chocolate. It should come as no surprise that caffeine tends to temporarily increase energy levels and alertness. It produces these effects by influencing the activity of a brain chemical called *adenosine*. When adenosine binds to its receptors in the brain, it slows down neural activity. In fact, it helps you become sleepy. Caffeine binds to adenosine receptors, but without causing a reduction in neural activity. In other words, it prevents adenosine from doing its job. At the same time, caffeine stimulates the adrenal glands to release adrenaline. This hormone accounts for the burst of energy associated with caffeine. Given that adrenaline is also associated with "fight or flight" responses, it may also explain why many

people feel jittery after consuming too much caffeine. Although no drug is harmless, the withdrawal effects associated with caffeine are far less severe than those found for other stimulants. Depriving yourself of caffeine will typically result in headaches, fatigue, and occasionally nausea; however, these symptoms will usually disappear after two to three days. Other stimulants are not so forgiving.

Cocaine is another commonly abused stimulant. It is synthesized from coca leaves, most often grown in South American countries such as Colombia, Peru, and Bolivia. The people who harvest these plants often take the drug in its simplest form—they chew on the leaves and experience a mild increase in energy. However, by the time it reaches Canadian markets, it has been processed into powder form. It is typically snorted and absorbed into the bloodstream through the nasal passages or, if prepared as crack cocaine, smoked in a pipe. Cocaine influences the nervous system by blocking the reuptake of dopamine in reward centres of the brain, although it can also influence serotonin and norepinephrine levels as well (see Figure 5.16). By preventing dopamine from being reabsorbed by the neuron that released it, cocaine increases the amount of dopamine in the synapse between the cells, thus making the postsynaptic cell more likely to fire. The result is an increase in energy levels and a feeling of euphoria.

Figure 5.16 Stimulant Effects on the Brain



Like many addictive drugs, cocaine and amphetamines stimulate the reward centres of the brain, including the nucleus accumbens and ventral tegmental area. Cocaine works by blocking the reuptake of dopamine, and methamphetamine works by increasing the release of dopamine at presynaptic neurons.

Watch Stimulant Effects on the Brain

Amphetamines, another group of stimulants, come in a variety of forms. Some are prescription drugs, such as methylphenidate (Ritalin) and modafinil (Provigil), which are typically prescribed for attention deficit hyperactivity disorder (ADHD) and narcolepsy, respectively. When used as prescribed, these drugs can have beneficial effects; oftentimes, however, these drugs are used recreationally. Other stimulants, such as methamphetamine, are not prescribed drugs. Methamphetamine, which stimulates the release of dopamine in presynaptic cells (see Figure 5.16), may be even more potent than cocaine when it comes to addictive potential. (*Crystal meth*, a drug made famous by the TV program *Breaking Bad*, is a form of methamphetamine that has undergone additional chemical refinement to remove impurities.) Methamphetamines are also notorious for causing significant neurological and external physical problems. For example, chronic methamphetamine abusers often experience deterioration of their facial features, teeth, and gums, owing to a combination of factors. First, methamphetamine addiction can lead to neglect of basic dietary and hygienic care. Second, the drug is often manufactured from a potent cocktail of substances, including hydrochloric acid and farm fertilizer—it is probably not surprising that these components can have serious side effects that harm a person's appearance and health.

Theresa Baxter was 42 when the picture on the left was taken. The photo on the right was taken 2.5 years later; the effects of methamphetamine are obvious and striking.

Multnomah County Sheriff/Splash/Newscom

Long-term use of potent stimulants like methamphetamines can actually alter the structure of the user's brain. Compared to non-users, people who have a history of abusing methamphetamine have been shown to have structural abnormalities of cells in the frontal lobes, which reduce the brain's ability to inhibit irrelevant thoughts (Tobias et al., 2010). This ability can be measured through the Stroop test (Figure 5.17), which challenges a person's ability to inhibit reading a word in favour of identifying its colour. Methamphetamine abusers had greater difficulty with this task than non-users.

Figure 5.17 The Stroop Task

The Stroop task requires you to read aloud the colour of the letters of these sample words. The task measures your ability to inhibit a natural tendency to read the word, rather than identify the colour. Chronic methamphetamine users have greater difficulty with this task than do non-users.

Changes in brain structure have also been noted in chronic users of **ecstasy** (3,4-methylenedioxy-*N*-methylamphetamine or **MDMA**), *a*

drug that is typically classified as a stimulant, but also has hallucinogenic effects (Cowan et al., 2008). MDMA was developed in 1912 by the German pharmaceutical company Merck KGaA; it was originally designed as a blood-clotting agent (Meyer, 2013). In the late 1970s, it was rediscovered by a chemist at the Dow chemical company, who described its emotional and sensual effects (Shulgin & Nichols, 1978). In the 1980s, it was labelled a "club drug" because of its frequent appearance at nightclub and rave parties. Ecstasy exerts its influence on the brain by stimulating the release of massive amounts of the neurotransmitter serotonin; it also blocks its reuptake, thereby ensuring that neurons containing serotonin receptors will fire at levels much greater than normal. Ecstasy heightens physical sensations and is known to increase social bonding and compassion among those who are under its influence. Unfortunately, this drug has also been linked to a number of preventable deaths. Heat stroke and dehydration are major risks associated with ecstasy use, especially when the drug is taken at a rave where there is a high level of physical exertion from dancing in an overheated environment. It can also lead to lowered mood two to five days after consumption, as it takes time for serotonin levels to return to normal (Curran & Travill, 1997).

It often comes as a surprise to learn that the very substances that people can become addicted to, or whose possession and use can even land them in prison today, were once ingredients in everyday products. Cocaine was once used as an inexpensive, over-the-counter pain remedy. A concoction of wine and cocaine was popular, and the drug was also added to cough syrups and drops for treating toothaches. Coca-Cola used to contain 9 mg of cocaine per glass; this practice ceased in 1903 (Liebowitz, 1983).

Advertising Archive/Courtesy Everett Collection

The long-term effects of ecstasy use are difficult to identify because most users of this drug also abuse other illegal substances. That said, recent neuroimaging studies with long-term ecstasy users have highlighted some of the effects this drug can have on the brain (Urban et al., 2012). For instance, several studies have shown that MDMA impairs the sensitivity of many visual regions in the occipital lobe (Oliveri & Calvo, 2003; White et al., 2013) as well as some parts of the frontal lobes (Roberts et al., 2018). These studies also show that chronic ecstasy users require more brain activity in order to perform cognitive tasks at the same level as non-users (Roberts et al., 2015). It should be noted, however, that the neural effects of ecstasy are not as pronounced in occasional users of the drug (Mueller et al., 2016). In fact, some researchers have suggested that occasional doses of ecstasy could be used alongside traditional psychotherapy when treating people with posttraumatic stress disorder (PTSD), a severe anxiety disorder involving intrusive memories of a traumatic event (see Module 16.3). A 2018 clinical trial found that 76% of the patients treated with MDMA no longer met the clinical criteria for PTSD (Ot'alora et al., 2018). However, given the potential dangers of MDMA, it is unlikely that these positive clinical results will lead to changes in the legal status of this drug.

Hallucinogens

Listen to the Audio

Hallucinogenic drugs, also known as **psychedelics**, *are substances that produce perceptual distortions*. Depending on the type of hallucinogen consumed, these distortions may be visual, auditory, and sometimes tactile in nature, such as the experience of crawling sensations against the skin. Hallucinogens also alter how people perceive their own thinking. For example, deep significance may be attached to what are normally mundane objects, events, or thoughts. One commonly used hallucinogen is **LSD (lysergic acid diethylamide)**, *which is a laboratory-made (synthetic) drug that triggers unusual sensory experiences*. A recent study examined brain activity of individuals after they had just taken LSD (Carhart-Harris et al., 2016). These researchers found that the LSD experience involves greater activity in visual areas. The scans also found that visual stimuli triggered activity in a number of areas outside of the visual cortex (see Figure 5.18); this activity strongly correlated with participants' reports of unusual visual experiences. The researchers also noted reduced connectivity between areas in the temporal and parietal lobe; these changes were related to feelings of "losing oneself" and finding "altered meanings." These results show the strong link between brain activity and moment-to-moment experiences.

Figure 5.18 LSD and the Brain

Taking LSD often leads to unusual sensory experiences. A 2016 study examined the brain activity associated with these experiences. One the left, you can see a normal neural response to viewing a visual stimulus after taking a placebo drug. On the right, you can see the brain response when someone views the same stimulus while on LSD. Note the activity in brain areas not typically associated with vision.

Hallucinogenic substances also occur in nature, such as psilocybin (a mushroom) and mescaline (derived from the peyote cactus). Hallucinogens can have very long-lasting effects—more than 12 hours for LSD, for example. These drugs may also elicit powerful emotional

experiences that range from extreme euphoria to fear, panic, and paranoia. The two most common hallucinogens, LSD and psilocybin, both act on the transmission of serotonin.

Short-acting hallucinogens have become increasingly popular for recreational use. The effects of two of these hallucinogens, *ketamine* and *DMT* (*dimethyltryptamine*), last for about an hour. Ketamine was originally developed as a surgical anesthetic to be used in cases where a gaseous anesthetic could not be applied, such as on the battlefield. It has been gaining popularity among university students as well as among people who frequent dance clubs and raves. Ketamine induces dream-like states, memory loss, dizziness, confusion, and a distorted sense of body ownership (i.e., feeling like your body and voice don't belong to you; Fu et al., 2005; Morgan et al., 2010). This synthetic drug blocks receptors for glutamate, which is an excitatory neurotransmitter that is important for, among other things, memory.

The short-acting hallucinogen known as DMT occurs naturally in such different places as the bark from trees native to Central and South America and on the skin surface of certain toads. DMT is even found in very small, naturally produced amounts in the human nervous system (Fontanilla et al., 2009). The function of DMT in the brain remains unclear, although some researchers have speculated that it plays a role in sleep and dreaming, and even out-of-body experiences (Barbanoj et al., 2008; Strassman, 2001). DMT is used in Canada primarily for recreational purposes. Users frequently report having intense "spiritual" experiences, such as feeling connected to or communicating with divine beings (as well as aliens, plant spirits, and other beings that aren't part of most modern people's version of reality). In fact, its ability to apparently enhance spiritual experiences has been well known in South American indigenous cultures. DMT is the primary psychoactive ingredient in *ayahuasca*, which plays a central role in shamanistic rituals involving

contact with the spirit world. An increasing number of Canadians have used another drug, *salvia divinorum*, for similar purposes.

Salvia divinorum *is an herb that grows in Central and South America. When smoked or chewed, salvia induces highly intense but short-lived hallucinations*. Use of this drug also leads to *dissociative experiences*—a detachment between self and body (Sumnall et al., 2011). Among the Mazateca people of Mexico, salvia is used in divine rituals in which an individual communicates with the spiritual world. Shamans of the Mazateca people use salvia for spiritual healing sessions, as they believe the drug has profound medicinal properties. At present, there is no scientific evidence to support this view. The legal status of salvia changed in February 2016. Previously, it had been listed as a natural product under the control of Health Canada; although technically illegal, regulations controlling salvia were not strictly enforced. However, it is now listed as a Schedule IV drug under the *Controlled Drugs and Substances Act*. It is illegal to sell, cultivate, or transport salvia.

Many hallucinogens can have serious negative consequences on users, ranging from memory problems to unwanted "flashbacks" in which the user re-experiences the visual distortions and emotional changes associated with the psychedelic state (Halpern & Pope, 2003). However, as you read in the introduction to this module, some hallucinogens are now being used to treat a number of clinical conditions. LSD has been used to help people deal with the anxiety associated with terminal illnesses (Gasser et al., 2015). Psilocybin (magic mushrooms), ayahuasca, and DMT have all been used to help reduce addiction to tobacco and alcohol (Tupper et al., 2015). Obviously these drugs are generally only used when traditional treatments are ineffective. But it does demonstrate that the line between "recreational drugs" and "medical drugs" is not as clear cut as we might think.

Opiates

Listen to the Audio

Opiates (*also called narcotics*) *are drugs such as heroin and morphine that reduce pain and induce extremely intense feelings of euphoria*. These drugs bind to endorphin receptors in the nervous system. Endorphins ("endogenous morphine") are neurotransmitters that reduce pain and produce pleasurable sensations—effects magnified by opiates. Naturally occurring opiates are derived from certain species of poppy plants that are primarily grown in Asia and the Middle East (particularly Afghanistan). Opiate drugs are very common in medical and emergency room settings. For example, the drug *fentanyl* is used in emergency rooms to treat people in extreme pain. A street version of fentanyl, known as "China White," can be more than 20 times the strength of more commonly sold doses of heroin. This drug is so dangerous that in April 2016, British Columbia declared a public health emergency after more than 200 people died from overdoses of the drug. Preventative policies have had little effect—nearly 4000 Canadians died from opioid overdoses in 2017 alone (an increase of 34% from 2016) (Government of Canada, 2017). Yet despite the well-publicized dangers, people continue to use it.

Treating opiate addiction can be incredibly challenging. Opiates produce very rapid and powerful "highs"; because the time between injecting or smoking opiates and their physical impact is so short, it is easy for people to mentally link the drug to the pleasurable feeling. This increases the addictiveness of these drugs. People who are addicted to opiates and other highly addictive drugs enter a negative cycle of having to use these

drugs simply to ward off withdrawal effects, rather than to actually achieve the sense of euphoria they may have experienced when they started using them. Methadone is an *opioid* (a synthetic opiate) that binds to opiate receptors but does not give the same kind of high that heroin does. A regimen of daily methadone treatment can help people who are addicted to opiates avoid painful withdrawal symptoms as they learn to cope without the drug. In recent years, newer alternatives to methadone have been found to be more effective and need to be taken only a few times per week.

Another opioid, oxycodone (OxyContin), has helped many people reduce severe pain while having relatively few side effects. Unfortunately, this drug, along with a similar product, Percocet, has very high abuse potential. It is often misused, especially by those who have obtained it through illegal means (i.e., without a prescription). Indeed, the abuse of prescription opiates is a growing problem in Canada, particularly among high school students and the elderly (Sproule et al., 2009); this topic will be discussed in more detail later in this module.

Legal Drugs and Their Effects on Consciousness

Listen to the Audio

So far we have covered drugs that are, for the most part, produced and distributed illegally. Some prescription drugs can also have profound effects on consciousness and, as a consequence, are targets for misuse.

Sedatives

Listen to the Audio

Sedative drugs, *sometimes referred to as "downers," depress activity of the central nervous system. Barbiturates* were an early form of medication used to treat anxiety and promote sleep. High doses of these drugs can shut down the brainstem regions that regulate breathing, so their medical use has largely been discontinued in favour of safer drugs. Barbiturates have a high potential for abuse, typically by people who want to lower inhibitions, relax, and try to improve their sleep. (Incidentally, while these agents may knock you out, they do not really improve the quality of sleep. Barbiturates actually reduce the amount of REM sleep.)

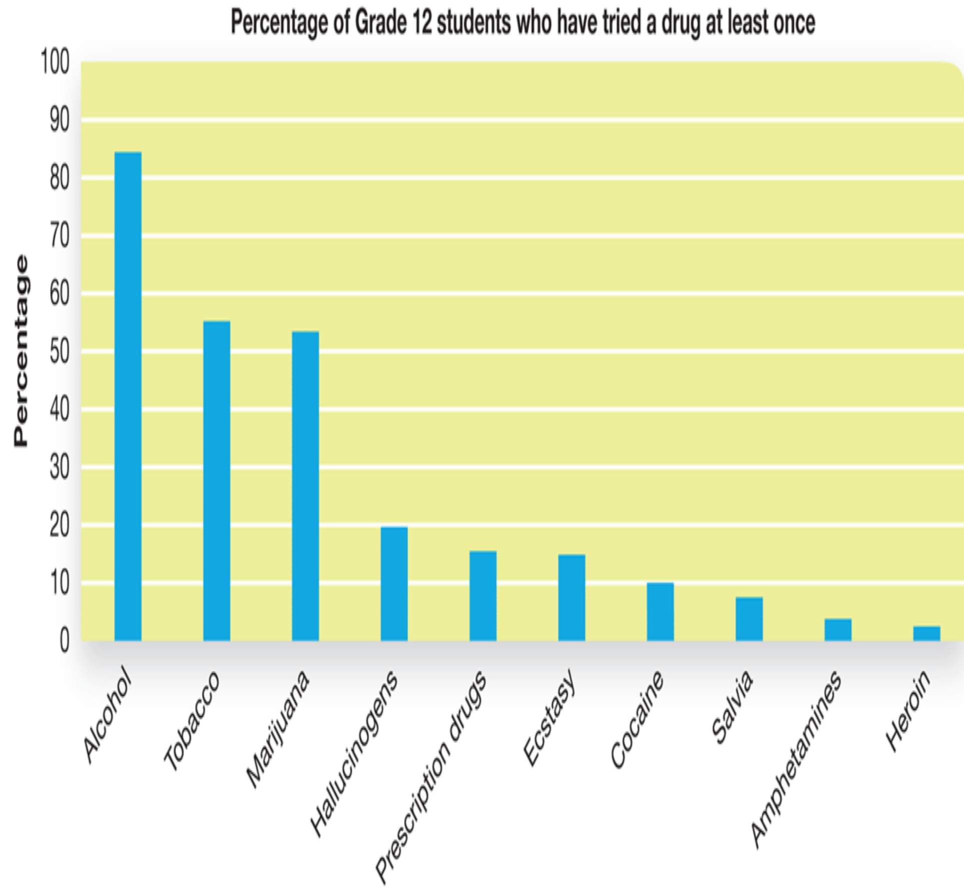
Newer forms of sedative drugs, called *benzodiazepines*, include prescription drugs such as Xanax, Ativan, and Valium. These drugs increase the effects of gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter that helps reduce feelings of anxiety or panic. The major advantage of benzodiazepine drugs over barbiturates is that they do not specifically target the brain regions responsible for breathing and, even at high doses, are unlikely to be fatal. However, people under the influence of any kind of sedative are at greater risk for injury or death due to accidents caused by their diminished attention, reaction time, and coordination.

Prescription Drug Abuse

Listen to the Audio

Prescription drugs are commonly abused by illicit users; over 15% of Canadian high school students have reported abusing prescription drugs at some point in their lives (Hammond et al., 2010; Figure 5.19). The prevalence of prescription drug abuse becomes even more extreme when these students enter university. Surveys have shown that as many as 31% of university students sampled have abused Ritalin, the stimulant commonly prescribed as a treatment for ADHD (Bogle & Smith, 2009).

Figure 5.19 Frequency of Drug Use among Grade 12 Students



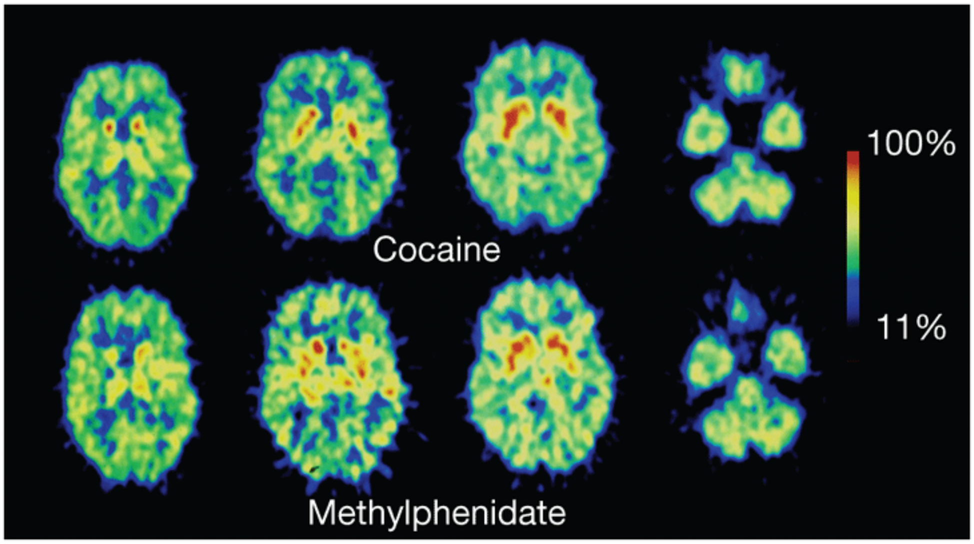
The abuse of prescription and over-the-counter drugs is becoming increasingly common in Canada. In a 2008 nationwide survey, over 15% of Grade 12 students admitted to illegally using these drugs at least once. This figure illustrates how the prevalence of prescription drug abuse compares to that of other frequently abused substances.

Source: Based on Hammond, D., Ahmed, R., Burkhalter, R., Sae Yang, W., & Leatherdale, S. (2010). Illicit substance use among Canadian youth: Trends between 2002 and 2008. *Canadian Journal of Public Health, 102*, 7–12.

A massive number of prescription drugs is available on the market, including stimulants, opiates, and sedatives. In 2011, 3.2% of Canadians (approximately 1.1 *million* people) used prescription drugs for nonmedical reasons within the year prior to the survey (Government of Canada, 2012). Users typically opt for prescription drugs as their drugs of choice because they are legal (when used as prescribed), pure (i.e., not contaminated or diluted), and relatively easy to get. Prescription drugs

are typically taken at large doses, and administered in such a way as to get a quicker, more intense effect—for example, by crushing and snorting stimulants such as Ritalin (see Figure 5.20).

Figure 5.20 Ritalin and Cocaine



Stimulants like methylphenidate (Ritalin) affect the same areas of the brain as cocaine, albeit with different speed and intensity.

The National Institute on Drug Abuse

Some of the most commonly abused prescription drugs in Canada are painkillers such as OxyContin. When used normally, OxyContin is a pain-reliever that slowly releases an opioid over the course of approximately 12 hours, thus making it a relatively safe product (Roth et al., 2000). However, crushing the OxyContin tablet frees its opioid component, oxycodone, from the slow-release mechanism; it can then be inhaled or dissolved in liquid and injected to provide a rapid "high" (Carise et al., 2007). Almost 80% of people entering treatment programs for OxyContin abuse admitted that the drug was not prescribed to them, suggesting that there is a flourishing trade in this drug. Indeed, a recent study of drug users in Vancouver found that OxyContin is quite easy to

purchase illegally in Canada (Nosyk et al., 2012); not surprisingly, the number of people entering drug rehabilitation programs for oxycodone abuse is also increasing (Sproule et al., 2009). In order to counteract this trend, Purdue Pharma Canada, the company that makes the drug, has replaced it with a similar substance, OxyNeo, that is more difficult to grind up into a powder. However, this action will likely have little effect on addiction rates—in April 2013, the federal government allowed *six* pharmaceutical companies to begin manufacturing generic (cheaper) versions of the drug.

Curbing prescription drug abuse poses quite a challenge, particularly given that many pharmaceutical companies attempt to curry favour with physicians by providing them with generous speaking fees and free meals (Hadland et al., 2018). One approach to reducing prescription drug abuse is to develop pain medications that do not act on pleasure and reward centres of the brain. A second approach, used by many Canadian communities, is to provide opportunities for people to safely dispose of unused prescription drugs; doing so helps remove unused drugs from actual or potential circulation. In addition, doctors and other health care professionals are becoming increasingly aware that some individuals seeking prescription drugs are doing so because they are addicted to them. The increased use of digital medical records may help prevent drug-seeking individuals from getting the same prescription from multiple doctors.

Alcohol

Listen to the Audio

Alcohol can be found in nearly every culture, although some frown on its use more than others. Alcohol use is a part of many cherished social and spiritual rituals, but is also associated with violence and accidents. It has the power to change societies, in some cases for the worse. Several decades ago, "problem drinking" was not an issue for the Carib people of Venezuela, for example. During specific yearly festivals, alcohol was brewed and consumed in limited amounts. In more recent years, the influence of Western civilization has led to the emergence of problems with alcohol abuse and alcoholism in this group of people (Seale et al., 2002). Most societies regard alcohol as an acceptable form of drug use, though they may attempt to limit and regulate its use through legal means. Customs and social expectations also affect usage. For example, drinking—especially heavy drinking—is generally considered more socially acceptable for men than for women (de Visser & McDonnell, 2012).

Alcohol has a number of effects on the brain. It initially targets GABA receptors, and subsequently affects opiate and dopamine receptors. The stimulation of opiate and dopamine receptors accounts for the euphoria associated with lower doses as well its rewarding effects. The release of GABA, an inhibitory neurotransmitter, reduces the activity of the central nervous system, which helps explain the impairments in balance and coordination associated with consumption of alcohol. But if alcohol increases the release of an inhibitory brain chemical, why do people

become *less* inhibited when they drink? The reason for this behaviour is that alcohol inhibits the frontal lobes of the brain. One function of the frontal lobes is to inhibit behaviour and impulses, and alcohol appears to impair the frontal lobe's ability to do so—in other words, it inhibits an inhibitor.

The lowered inhibitions associated with alcohol may help people muster the courage to perform a toast at a wedding, but many socially unacceptable consequences are also associated with alcohol use. Alcohol abuse has been linked to health problems, sexual and physical assault, automobile accidents, missing work or school, unplanned pregnancies, and contracting sexually transmitted diseases (Griffin et al., 2010). These effects are primarily associated with heavy consumption, which can often lead to *alcohol myopia* (Steele & Josephs, 1990). When intoxicated, people often pay more attention to cues related to their desires and impulses (e.g., the attractive-looking person on the couch at the party) and less attention to cues related to inhibiting those desires (e.g., friends telling them to stop drinking, or the lecture about safe sex that they received in their sex-education class). This tendency to focus on short-term rewards rather than long-term consequences is particularly noticeable in underage drinkers whose frontal lobes (which help inhibit behaviour) are not fully developed. Alcohol myopia is also more likely to occur in people with low self-esteem; these individuals may focus on their fear of social rejection and respond by engaging in risky behaviours that they feel will lead to social acceptance (MacDonald & Martineau, 2002).

Psych@

University Parties

Researchers have determined that university students drink significantly more than their peers who do not attend university (Carter et al., 2010). However, although heavy drinking—particularly on the weekend—is often associated with positive emotions (Howard et al., 2015), it can lead to some serious consequences for students. In one study, nearly half of the university student participants binge-drank, one-third drove under the influence, 10% to 12% sustained an injury or were assaulted while intoxicated, and 2% were victims of date rape while drinking (Hingson et al., 2009). Alcohol abuse in our society is widespread, especially during times of celebration (Glindemann et al., 2007), so it might seem as if universities have few options at their disposal to reduce reckless drinking on campus. Psychologists Kent Glindemann, Scott Geller, and their associates, however, have conducted some interesting field studies in fraternity houses at their U.S. university. For example, in two separate studies, these researchers measured the typical blood-alcohol level at fraternity parties. They then offered monetary awards or entry into a raffle for fraternities that could keep their average blood-alcohol level below 0.05 at their next party. The interventions proved to be successful in both studies, with blood-alcohol levels being significantly reduced from the baseline (Fournier et al., 2004; Glindemann et al., 2007).

Marijuana

Listen to the Audio

The final drug to be discussed in this module was only recently legalized in Canada. **Marijuana** is *a drug comprising the leaves and buds of the* Cannabis *plant that produces a combination of hallucinogenic, stimulant, and relaxing (narcotic) effects*. These buds contain a high concentration of a compound called tetrahydrocannabinol (THC). THC mimics *anandamide*, a chemical that occurs naturally in the brain and the peripheral nerves. Both anandamide and THC bind to cannabinoid receptors and induce feelings of euphoria, relaxation, reduced pain, and heightened and sometimes distorted sensory experiences (Edwards et al., 2012; Ware et al., 2010). They also stimulate one's appetite (Kirkham, 2009). Although "having the munchies" might seem like a funny side effect for recreational users, it is an incredibly important benefit for cancer sufferers who use medicinal marijuana to counteract the nausea and lack of appetite that occurs following chemotherapy (Machado Rocha et al., 2008).

From the above list, it is clear that marijuana use can affect a number of different behaviours. Missing from this list, however, are the effects that this drug can have on our cognitive abilities.

Working the Scientific Literacy Model

Marijuana, Memory, and Cognition

Listen to the Audio

No one doubts that marijuana affects a person's thinking and behaviour. That said, descriptions of the exact nature of these effects are often more anecdotal than scientific. The earliest reference to marijuana is found in the ancient Hindu text *Raja Nirghanta*, which translates the drug as "promoter of success," "the cause of the reeling gait," and "the laughter moving" (see Chopra & Chopra, 1957). Indeed. More recent descriptions have noted that marijuana's effects on one's ability to think are both widespread and testable.

What do we know about the effects of marijuana on memory and cognition?

Studies of people under the influence of marijuana have demonstrated a number of different impairments to memory processes (Crean et al., 2011). Several researchers have confirmed that marijuana disrupts short-term memory (Ranganathan & D'Souza, 2006). Studies of long-term memory have indicated that marijuana use was associated with a reduced ability to recall information (Auer et al., 2016) and a greater tendency to commit intrusion errors—adding in words that were not actually on a list of to-be-remembered items (Hooker & Jones, 1987; Pfefferbaum et al., 1977). Marijuana also affects a number of cognitive abilities. Executive functions, such as

decision making and the control of attention, are critical for dealing with novel situations and for changing or inhibiting responses to stimuli in the environment. Many executive functions are impaired by THC. For instance, marijuana impairs people's ability to problem solve and to change their strategies while performing a task (Bolla et al., 2002; Pope et al., 2003). It may impair creative thinking and attention as well (Hermann et al., 2007; Kowal et al., 2015).

How can science explain these effects?

Neuroimaging results indicate that the memory and cognitive difficulties experienced by people who smoke marijuana are likely related to changes in their brains. A number of studies have noted that reduced performance on memory tests is related to decreases in brain activity in the right frontal lobe (Block et al., 2002; Jager et al., 2007), an area involved with memory retrieval (Tulving et al., 1994). Interestingly, some researchers have found that even when marijuana users and healthy control participants produce the same results on a memory test, their brains generate different patterns of activity. For instance, Kanayama and colleagues (2004) found that participants who had recently smoked marijuana (< 24 hours ago) were able to perform a spatial memory task; but doing so recruited a much more widespread network of brain regions, including several that are not typically associated with memory. This suggests that the brains of marijuana users need to work harder to reach the same level of performance, oftentimes relying on additional brain structures to meet the demands of the task (Jager et al., 2006).

Problems with executive functions can also be explained, at least in part, by differing patterns of brain activity. The inability to inhibit responses on a Stroop task (which was discussed earlier in this module) was related to the fact that marijuana users had less

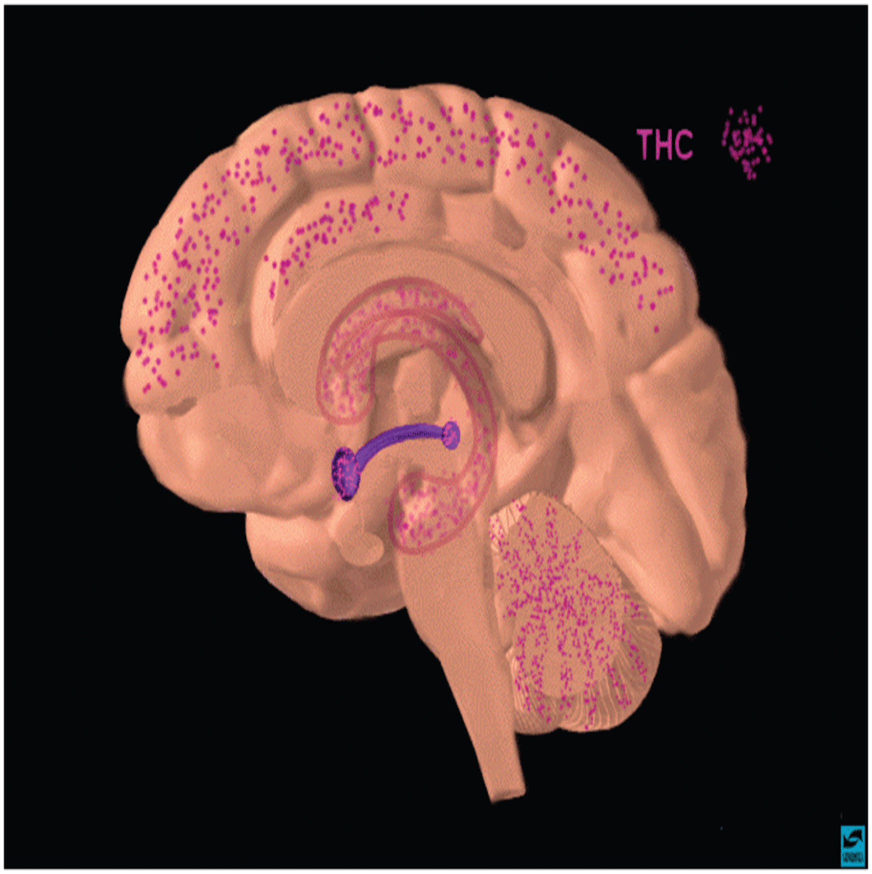
activity than healthy controls in a number of frontal-lobe regions (Eldreth et al., 2004; Gruber & Yurgelun-Todd, 2005). These studies also demonstrated that, similar to the memory studies, the brains of marijuana users had additional activity in areas not typically associated with the task they were performing. In other words, these brains had to find alternative networks to allow them to compensate for the effects of marijuana so that they could still perform the task (Martín-Santos et al., 2010).

Can we critically evaluate this information?

When we look at these data, we have to remember that fMRI activity is correlational. The orange and yellow "lights" in the brain pictures represent areas that are activated at the same time that a person is performing a task; but it doesn't mean that those areas are causing the person's behaviour. More importantly, we have to think of the participants in drug studies. Many of the people involved in these studies use more than one drug (e.g., marijuana plus alcohol, tobacco, and possibly other drugs). It is therefore difficult to isolate the effects of marijuana *by itself* on cognition.

One way to get around these problems is to look at which areas of the brain are involved with these different abilities and then see if marijuana targets those areas. As it turns out, a receptor sensitive to THC, the cannabinoid (CB1) receptor, is found throughout the hippocampus and in the medial part of the frontal lobes (Pertwee & Ross, 2002; see Figure 5.21). Importantly, stimulating these receptors can lead to impairments in short-term memory and higher-level thinking (Ranganathan & D'Souza, 2006). Thus, there is a cellular-level mechanism that can explain (some of) the odd behaviours that you see when people are smoking up.

Figure 5.21 CB1 Receptors in the Brain



The locations of the CB1 receptors, which bind to the active ingredient in marijuana, help explain the diverse effects users often experience. CB1 receptors are found in the frontal lobes (executive functions), hippocampus (memory), and cerebellum (coordination of movement). They are also found in the nucleus accumbens, an area related to the rewarding feeling associated with many drugs.

Courtesy of National Institute of Drug Abuse

Why is this relevant?

Marijuana use seems, to many people, harmless and funny. What's so bad about spending hours getting high, watching cartoons, and eating chips? But, although occasional use has not been linked to serious cognitive consequences, recent

brainimaging studies of long-term smokers showed reduced amounts of grey matter (neurons) in memory regions of the temporal lobe (Battistella et al., 2014); there were also fewer white-matter connections involving this brain area (Zalesky et al., 2012). In other words, chronic marijuana use can influence how parts of the brain transmit and receive information. Heavy long-term use of marijuana is also related to a four-point decline in IQ scores (a number that isn't huge, but is still something to think about; Fried et al., 2002). Importantly, the strains of marijuana that are currently available tend to be higher in THC content than the strains available to previous generations of drug users (Hardwick & King, 2008). It is possible, therefore, that the small cognitive deficits found in current studies of long-term marijuana users may be magnified in young people who are just beginning to use this drug.

Marijuana and the Teenage Brain

Listen to the Audio

Marijuana use often starts during the teenage years. From a neurological perspective, early drug use is a particular cause for concern (Lubman et al., 2015). The brain develops in a step-by-step fashion, with higher-order cognitive areas—particularly the frontal lobes—developing after other areas have fully matured (Gogtay et al., 2004). As part of this step-by-step development, the white-matter fibres connecting brain regions grow and form new connections while unnecessary synapses are pruned away. Marijuana use during the teenage years has been shown to impair both of these developmental processes (Gruber et al., 2014). It has also been linked with thinning (i.e., fewer cells) in a number of cortical areas (Mashhoon et al., 2015; Price et al., 2015) and smaller hippocampal volumes (Ashtari et al., 2009).

These changes in the brain's development can affect cognitive abilities. Increasing evidence indicates that the effects of marijuana on memory and executive functions are much larger in people who started taking the drug before the age of 17 (Brook et al., 2008; Pope et al., 2003). In other words, using marijuana during an earlier stage of development can have a much larger effect on a person's future than if the same dose were to be consumed or smoked later in life (Squeglia et al., 2009). These data therefore suggest that prevention programs should specifically target teens to ensure that their cognitive abilities don't go up in smoke.

It is important to note that if you *did* smoke marijuana before the age of 17, your life isn't ruined. It just means that if you continue to frequently use marijuana, you are statistically more likely to have memory and executive functioning programs later in life. It is quite possible that your brain will recover. You can help it bounce back by reducing your consumption of drugs and by engaging in behaviours that help increase the thickness of white-matter pathways in the frontal lobes (e.g., mindfulness training; see Modules 14.3 and 16.2). So, you have a lot of control over what happens to your brain.

Currently, marijuana is the most commonly used recreational drug in Canada. Indeed, a survey released in October 2018 showed that that 27% of Canadians aged 15–24 had used marijuana in the three months prior to the survey (Statistics Canada, 2018). This high usage rate reflects, in part, the fact that this drug has traditionally been so readily available. It remains to be seen whether the number of teens and young adults using marijuana will be affected by the legalization of marijuana.

Why Are Some Drugs Legal and Others Illegal?

Listen to the Audio

On October 17, 2018, marijuana was legalized in Canada. People across the country lined up—in some cases for hours—at midnight to purchase marijuana from registered retailers. Provincial governments reported millions of dollars in purchases in the first week alone. This recent change in the legal status of marijuana in Canada (and in some U.S. states) leads us to an interesting question: Why are some drugs legal and others illegal?

It is relatively easy to understand some decisions, such as making drugs with intense effects (such as opium) illegal, but allowing chemically similar drugs with weaker effects (such as OxyContin) to be legal (at least, with prescriptions). But some distinctions are less clear. Nicotine is more addictive than THC, the active ingredient in marijuana, yet the sale of tobacco products is legal while the sale of marijuana is not legal in most parts of the world. As you read earlier in this module, alcohol can lead to violence and many risky behaviours; marijuana's most dangerous effects are to the lungs and to short-term memory (and perhaps the waistline). One possible argument for the difference is that we know much more about how alcohol affects behaviours such as driving. The Breathalyzer is a relatively effective method of measuring blood alcohol levels, and researchers have tested the effects of alcohol on driving ability. There is much more uncertainly about the effects of marijuana on driving. This is obviously concerning, particularly given that one in seven

marijuana users admitted to driving within two hours of smoking up (Statistics Canada, 2018). Based on this paragraph alone, you can see how people could strongly favour—or oppose—the legalization of marijuana. The decision to legalize or criminalize a drug is not a simple one.

Some countries, such as Portugal, *have* gone ahead and decriminalized drugs. The rationale for doing so was that the "War on Drugs" was not decreasing addiction rates but was costing billions of dollars to fight. Neighbouring countries were understandably nervous—if Portugal turned into a drug haven, this activity would undoubtedly affect other Mediterranean nations. However, an examination of drug use in Portugal, Spain, and Italy suggests that decriminalization had little effect on drug use. Between 2001 (the year Portugal decriminalized drugs) and 2007, the number of Portuguese people who reported consuming any recreational drug in the previous 12 months increased 0.3%. These results were almost identical to drug use in Spain and were *lower* than the levels of drug use in Italy, even though drugs were illegal in both of those countries (Hughes & Stevens, 2010).

The purpose of this section is not to promote one drug or another, nor is it to promote any political agenda. Rather, this information *should* promote critical thinking and the use of science when making decisions. Today's young people will likely be asked to make legal decisions about a number of drugs ranging from magic mushrooms to several often-abused prescription drugs. Using rigorously controlled experiments to test the physiological and psychological effects of different drugs—and paying attention to the effects of different drug policies in other countries—will help people make informed decisions about whether or not particular substances should be banned.

Module 5.3 Summary

Listen to the Audio

5.3a Know . . . The key terminology related to different categories of drugs and their effects on the nervous system and behaviour.

Review Module 5.3

Start Over Swap

0/13 REVIEWED · 0 MASTERED

tolerance

Previous Next Got It!

5.3b Understand . . . drug tolerance and dependence.

Tolerance is a physiological process in which repeated exposure to a drug leads to a need for increasingly larger dosages to experience the intended

effect. Physical dependence occurs when the user takes a drug to avoid withdrawal symptoms. Psychological dependence occurs when people feel addicted to a drug despite the absence of physical withdrawal symptoms; this form of dependence is often related to a person's emotional reasons for using a drug (e.g., dealing with stress or negative emotions).

5.3c Apply . . . your knowledge to better understand your own beliefs about drug use.

Apply Activity

One tool that might help you in this regard is the scale in Table 5.4.

Table 5.4 What Are Your Beliefs about Drug Use?

For each, select the response that represents your level of agreement. After you have completed the survey, you'll see your final score.

Previous Next

Note: This scale measures permissive attitudes toward substance use and abuse. Higher scores indicate more permissive attitudes.

Source: Reproduced with the permission of Alcohol Research Documentation, Inc. publisher of the *Journal of Studies on Alcohol* (now the *Journal of Studies on Alcohol and Drugs* [www.jsad.com]).

5.3d Analyze . . . the difference between spiritual and recreational drug use.

The difference, such as in the case of salvia divinorum and ayahuasca, is dependent upon cultural factors, the setting in which the drug is used, and the expectations of the user.

5.3e Analyze . . . the short- and long-term effects of drug use.

Review Table 5.3 for a summary of short-term effects of the major drug categories. Long-term effects of drug use include tolerance, physical dependence, and psychological dependence. Additionally, long-term use of a number of drugs can change the structure of the brain, leading to permanent deficits in a number of cognitive and physical abilities.

Chapter 6
Learning

Listen to the Audio

6.1 Classical Conditioning: Learning by Association

- Pavlov's Dogs: Classical Conditioning of Salivation
- Processes of Classical Conditioning
- Applications of Classical Conditioning
- Working the Scientific Literacy Model: Conditioning and Negative Political Advertising
- Module 6.1 Summary

6.2 Operant Conditioning: Learning through Consequences

- Basic Principles of Operant Conditioning
- Processes of Operant Conditioning
- Reinforcement Schedules and Operant Conditioning
- Working the Scientific Literacy Model: Reinforcement and Superstition
- Module 6.2 Summary

6.3 Cognitive and Observational Learning

- Cognitive Perspectives on Learning
- Observational Learning

Working the Scientific Literacy Model: Linking Media Exposure to Behaviour

Module 6.3 Summary

Module 6.1 Classical Conditioning: Learning by Association

Listen to the Audio

Brenda Carson/Fotolia

Learning Objectives

6.1a Know . . . the key terminology involved in classical conditioning.

6.1b Understand . . . how responses learned through classical conditioning can be acquired and lost.

6.1c Understand . . . the role of biological and evolutionary factors in classical conditioning.

6.1d Apply . . . the concepts and terms of classical conditioning to new examples.

6.1e Analyze . . . the use of negative political advertising to condition emotional responses to candidates.

What do you think of when you smell freshly baked cookies? Chances are you associate the smell of cookies with your mother or grandmother, and immediately experience a flood of memories associated with them. These associations form naturally. It is quite unlikely that your grandmother shoved a chocolate chip cookie under your nose and screamed, "Remember me!" Instead, you linked these two stimuli together in your mind; now, the smell of cookies is associated with the idea of grandmother. This ability to associate stimuli provides important evolutionary advantages: It means that you can use one stimulus to predict the appearance of another, and that your body can initiate its response to the second stimulus before it even appears. Although the link between your grandmother and the smell of cookies is not vital to your survival, similar associations such as the smell of a food that made you sick and a feeling of revulsion just might be. Interestingly, we are not the only species with this ability—even the simplest animals (such as the earthworm) can learn by association, suggesting that these associations are in fact critical for survival. In this module, we will explore the different processes that influence how these associations form.

Learning *is a process by which behaviour or knowledge changes as a result of experience*. To many people, the term *learning* signifies the activities that students do—reading, listening, and taking tests in order to acquire new information. This process, which is known as *cognitive learning*, is just one type of learning, however. Another way that we learn is by *associative learning*, which is the focus of this module.

Pavlov’s Dogs: Classical Conditioning of Salivation

Listen to the Audio

Research on associative learning has a long history in psychology, dating back to Ivan Pavlov (1849–1936), a Russian physiologist and the 1904 Nobel laureate in medicine (for work on digestion, *not* his now-famous conditioning research). Pavlov studied digestion, using dogs as a model species for his experiments. As a part of his normal research procedure, he collected saliva and other gastric secretions from the dogs when they were presented with meat powder. Pavlov and his assistants noticed that as they prepared dogs for procedures, even before any meat powder was presented, the dogs would start salivating. This curious observation led Pavlov to consider the possibility that digestive responses were more than just simple reflexes elicited by food. If dogs salivate *in anticipation* of food, then perhaps the salivary response can also be learned (Pavlov’s lab assistants referred to them as “psychic secretions”). Pavlov began conducting experiments in which he first presented a sound from a metronome, a device that produces ticking sounds at set intervals, and then presented meat powder to the dogs. After pairing the sound with the food several times, Pavlov discovered that the metronome could elicit salivation by itself (see Figure 6.1).

Figure 6.1 Associative Learning

Although much information may pass through the dog's brain, in Pavlov's experiments on classical conditioning an association was made between the clicking sound of a metronome and the food. (Pavlov used a metronome as well as other devices for presenting sounds.)

Pavlov's discovery began a long tradition of inquiry into what is now called **classical conditioning** or **Pavlovian conditioning**—*a form of associative learning in which an organism learns to associate a neutral stimulus (e.g., a sound) with a biologically relevant stimulus (e.g., food), which results in a change in the response to the previously neutral stimulus (e.g., salivation)*. You can think about classical conditioning in mechanical terms—that is, one event causes another. A *stimulus* is an external event or cue that elicits a perceptual response; this occurs regardless of whether the event is important or not. Some stimuli—such as food, water, pain, or sexual contact—elicit responses instinctively (i.e., without any learning being required). Each of these is an example of an **unconditioned stimulus (US)**, *a stimulus that elicits a reflexive response without learning*. An **unconditioned response (UR)**, on the other hand, *is a reflexive,*

unlearned reaction to an unconditioned stimulus. URs could include hunger, drooling, expressions of pain, and sexual responses. Again, you do not need to learn these; they occur fairly automatically. In Pavlov's experiment, meat powder elicited unconditioned salivation in his dogs (see the top panel of Figure 6.2). The link between the US and the UR is, by definition, unlearned. The dog's parents did not have to teach it to salivate when food appeared; this response occurs naturally.

Figure 6.2 Pavlov's Salivary Conditioning Experiment

By definition, unconditioned stimuli such as food elicit unlearned, reflexive, unconditioned responses (salivation, in this case).

1 of 4 Previous Next

Food elicits the unconditioned response of salivation. Before conditioning, the sound of the metronome elicits no response by the dog. During conditioning, the metronome's clicking repeatedly precedes the food. After conditioning, the sound of the metronome alone elicits salivation. Interestingly, the term *conditioning* was actually a translation error. Pavlov initially used the term *conditional* stimulus to describe stimuli that were previously unimportant (or neutral) but that later acquired greater significance due to their ability to signal the upcoming occurrence (or, in some cases, nonoccurrence) of a biologically important stimulus. These stimuli can be contrasted with stimuli such as food, which are relevant to an animal's survival and therefore trigger an almost

automatic—or “unconditional”—response such as salivating. These terms were mistranslated into English as *conditioned* and *unconditioned*.

A defining characteristic of classical conditioning is that a neutral stimulus comes to elicit a response. It does so because the neutral stimulus is paired with, and therefore predicts, an unconditioned stimulus. In Pavlov’s experiment, the sound of the metronome was *originally* a neutral stimulus because it did not elicit a response, least of all salivation (see Figure 6.2); however, over time, it began to influence the dogs’ responses because of its association with food. In this case, the metronome became a **conditioned stimulus (CS)**, *a once-neutral stimulus that later elicits a conditioned response because it has a history of being paired with an unconditioned stimulus*. A **conditioned response (CR)** *is the learned response that occurs to the conditioned stimulus*. In other words, after being repeatedly paired with the US, the once-neutral metronome clicking in Pavlov’s experiment became a conditioned stimulus (CS) because it elicited the conditioned response of salivation. To establish that conditioning has taken place, the metronome’s sound (CS) must elicit salivation in the *absence* of food (US; see the bottom panel of Figure 6.2).

A common point of confusion is the difference between a conditioned response and an unconditioned response—in Pavlov’s experiment, they are both salivation. What distinguishes the UR from the CR is the stimulus that elicits them. Salivation is a UR if it occurs in response to a US (food). Salivation is a CR if it occurs in response to a CS (the clicking of the metronome). A CS can have this effect only if it becomes *associated* with a US. In other words, a UR is a *naturally occurring* response whereas a CR must be *learned*.

Review Applying Classical Conditioning

Many, if not most, children dread going to the doctor because they do not want to have shots. Classical conditioning is involved in acquiring this negative response. Insertion of the needle elicits a painful sensation. Following this, sight of the needle elicits fear/anxiety. Identify the CS, US, UR, and CR in this scenario.

Response	Event
CS	the needle
US	the injection
UR	pain
CR	fear/anxiety

Check Your Understanding

Evolutionary Function of the CR

Listen to the Audio

In Pavlov's original experiments, the response to the signal (after pairings) and to food were exactly the same: salivation. It is important to note that the UR and CR do *not* have to be identical. In Pavlov's study, it made good evolutionary sense to salivate just prior to receiving food. Saliva moisturizes the mouth and is a critical first step in the digestive process. An animal with the ability to prepare in this way would process food more efficiently. Therefore, the CR of salivation served a useful function. Following this line of thinking, what do you think would happen if the US was unpleasant, painful, and potentially life threatening? The answer from an evolutionary perspective is pretty obvious: avoid death and minimize physical damage.

Many animals have an instinct to "freeze" when they are scared. You see this when deer are caught in headlights. They remain motionless—why? The reason is that many of their predators, such as the wolf, have perceptual systems that are quite sensitive to detecting movement; so remaining still has an evolutionary survival advantage. (Highways weren't part of the evolution of deer.) However, if the wolf were to begin to stalk the deer, the deer should immediately stop freezing and run. So, there are two different defensive responses associated with fear: freezing and fleeing.

Psychologists have spent decades trying to study these defensive responses in the lab (although these experiments used rodents rather

than the potentially more dramatic combination of deer and wolves). For instance, many conditioning experiments have studied the ability of rats to associate a cue (e.g., a tone) with a painful electric shock to their feet. Some of the URs to shock include flinching, jumping, and pain. However, once the rat has learned to associate the tone with the shock, the rat's primary learned response to the tone is to "freeze" (the CR). The freezing CR has served many species well for millions of years, so it is the natural response to a fear-inducing signal in the laboratory. The lesson from this experimental situation is that UR and the CR are often quite different responses. The evolutionary function of the CR can be seen as a way for the organism to interact adaptively with the US (Domjan & Krause, 2017). In the case of a food US, conditioned salivation prepares the organism for eating, and if the US is a predator, the CR functions to facilitate survival.

The UR and CR sometimes differ. CRs are often evolutionarily useful behaviours such as the "freezing" response.

SCS Studio/Corbis/Getty Images

This example isn't meant to confuse you! Rather, it is to show you that classical conditioning has a dramatic effect on an organism's survival. In other words, conditioning has an evolutionary *function*, and so the CR and the UR are not necessarily the same response.

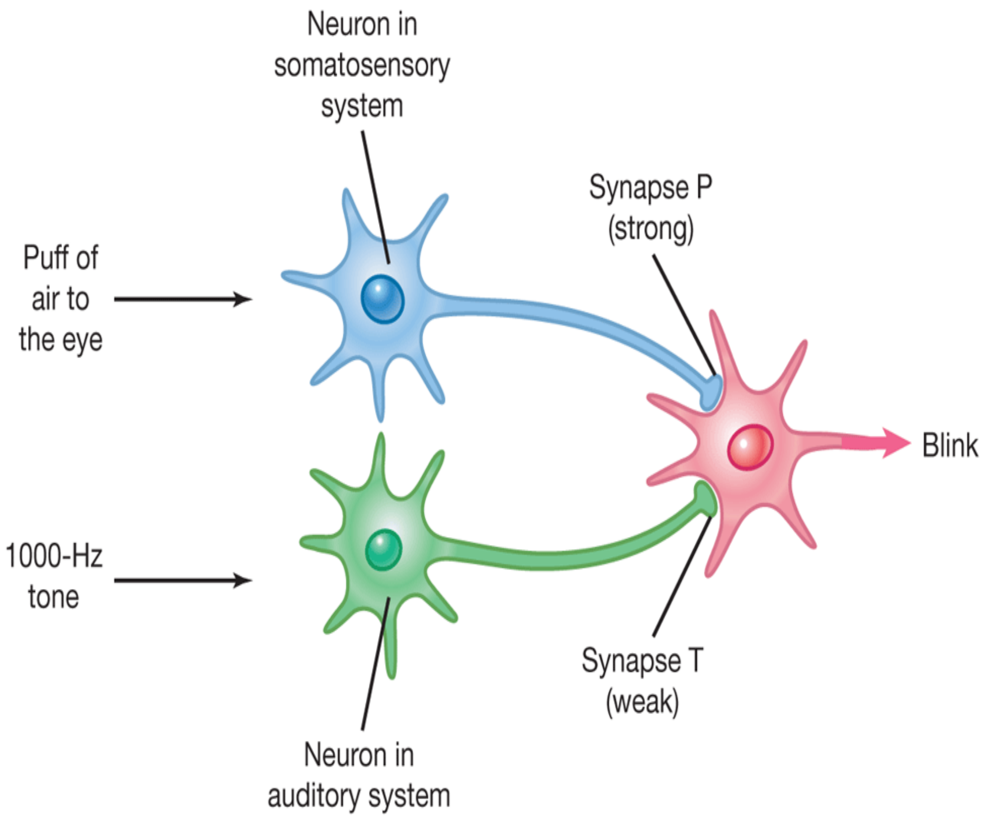
Classical Conditioning and the Brain

Listen to the Audio

Classical conditioning can occur in extremely simple organisms such as *Aplysia*, a type of sea slug (Hawkins, 1984; Pinsker et al., 1970). Of course, the number of possible conditioned responses is more limited in the sea slug than in humans. But the fact that both of these species can be classically conditioned suggests that at its heart, classical conditioning is a simple biological process. The connections between specific groups of neurons (or specific axon terminals and receptor sites on neurons) become strengthened during each instance of classical conditioning (Murphy & Glanzman, 1997).

According to the Hebb Rule (named after Canadian neurologist Donald Hebb; see Module 7.1), when a weak connection between neurons is stimulated at the same time as a strong connection, the weak connection becomes strengthened. So, before conditioning, there may be a strong connection between perceiving a puff of air and a blinking response and a weak connection between a sound (e.g., a brief tone) and the blinking response. But, if both networks are stimulated at the same time, the link between the sound and the blinking response would be strengthened. Over repeated conditioning trials, this connection would become strong enough that the sound itself would trigger an eyeblink (see Figure 6.3).

Figure 6.3 Conditioning and Synapses



During conditioning, weak synapses fire at the same time as related strong synapses. The simultaneous activity strengthens the connections in the weaker synapse.

Source: Carlson, Neil R. (2013) *Psychology of Behavior*, 11th ed., Copyright © 2013, 29, 72. Reprinted and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

When reading these examples, it's quite easy to think of conditioning as something unrelated to your life. Not many of us undergo eyeblink conditioning. But these principles still apply to your everyday existence. For instance, most of you have received a needle at the doctor's office. In this situation, the needle caused a response of pain. The doctor's office itself did not harm you in any way. But, over time, you may start to feel anxious whenever you enter the doctor's office because it has been repeatedly paired with pain. What do you think the US, UR, CS, and CR would be in this situation? In this case, the needle (US) causes pain (UR). The office is the neutral stimulus (NS). Over time, the sights and sounds

of the doctor's office could be the CS, because it would trigger the CR (fear). Importantly, as you will read in the next section, the strength of these networks—and thus of the conditioning—will vary depending upon how often and how consistently the CS and the US appear together.

Processes of Classical Conditioning

Listen to the Audio

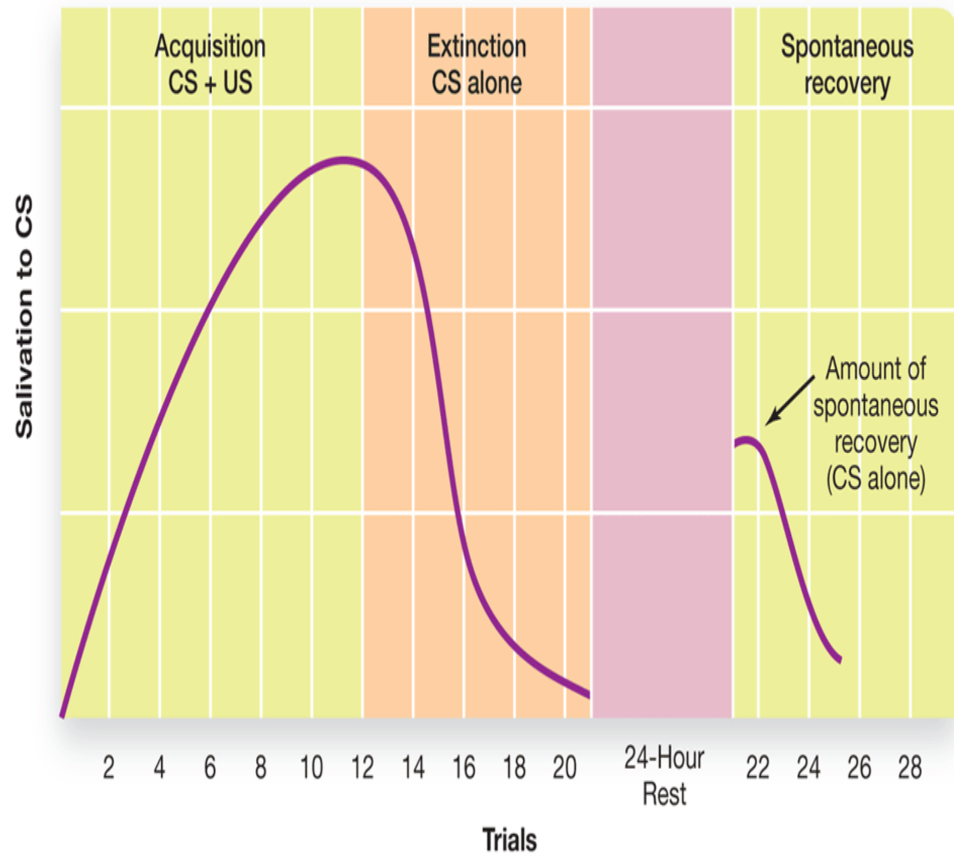
Although classically conditioned responses typically involve reflexive actions, there is still a great deal of flexibility in how long they will last and how specific they will be. Conditioned responses may be very strong and reliable, which is likely if the CS and the US have a long history of being paired together, or the CR prepares the organism (people included) to interact with a US that may either threaten or enhance survival. Also, conditioned responding may diminish over time, or it may occur with new stimuli with which the response has never been paired. We now turn to some processes that account for the flexibility of classically conditioned responses.

Acquisition, Extinction, and Spontaneous Recovery

Listen to the Audio

Learning involves a change in behaviour due to experience, which can include acquiring a new response. **Acquisition** *is the initial phase of learning in which a response is established*; thus, in classical conditioning, acquisition is the phase in which a neutral stimulus is repeatedly paired with the US. In Pavlov's experiment, the conditioned salivary response was *acquired* with numerous metronome–food pairings (see Figure 6.4). A critical part of acquisition is the predictability with which the CS and the US occur together. In Pavlov's experiment, conditioning either would not occur or would be very weak if food was delivered only sometimes (i.e., inconsistently) when the metronome sound occurred.

Figure 6.4 Acquisition, Extinction, and Spontaneous Recovery



Acquisition of a conditioned response occurs over repeated pairings of the CS and the US. If the US no longer occurs, conditioned responding diminishes—a process called *extinction*. Often, following a time interval in which the CS does not occur, conditioned responding rebounds when the CS is presented again—a phenomenon called *spontaneous recovery*.

Of course, even if a conditioned response is fully acquired, there is no guarantee it will persist forever. **Extinction** *is the reduction of a conditioned response when a conditioned stimulus and unconditioned stimulus no longer occur together*. For the dogs in Pavlov's experiment, if the sound of the metronome clicking is presented repeatedly and no food follows, then salivation should occur less and less, until eventually it may not occur at all (Figure 6.4). This trend probably makes sense from a biological perspective: If the sound of the metronome is no longer a reliable predictor of food, then salivation in response to this particular

stimulus becomes unnecessary. At the neural level, the rate of firing in brain areas related to the learned association decreases over the course of extinction (Robleto et al., 2004). However, even after extinction occurs, a previously established conditioned response can return.

A number of studies have shown that classically conditioned behaviours that had disappeared due to extinction could quickly reappear if the CS was paired with the US again. This tendency suggests that the networks of brain areas related to conditioning were preserved, or altered, in some form (Schreurs, 1993; Schreurs et al., 1998). Additionally, some animals (including humans) show **spontaneous recovery**, *or the reoccurrence of a previously extinguished conditioned response, typically after some time has passed since extinction*. Pavlov and his assistants noticed that salivation would reappear when the dogs were later returned to the experimental testing room where acquisition and extinction trials had been conducted. The dogs would also salivate again in response to a metronome clicking, albeit less so than at the end of acquisition (Figure 6.4). Why would salivation spontaneously return after the response had supposedly extinguished? One possibility is that extinction also involves learning something new (Bouton, 1994). In this case, Pavlov's dogs would be learning that the clicking of a metronome indicates that food will *not* appear. It is possible that spontaneous recovery is a case of the animal not being able to retrieve the memory of extinction and thus reverting back to the original memory, the classically conditioned response (Bouton, 2002; Brooks et al., 1999).

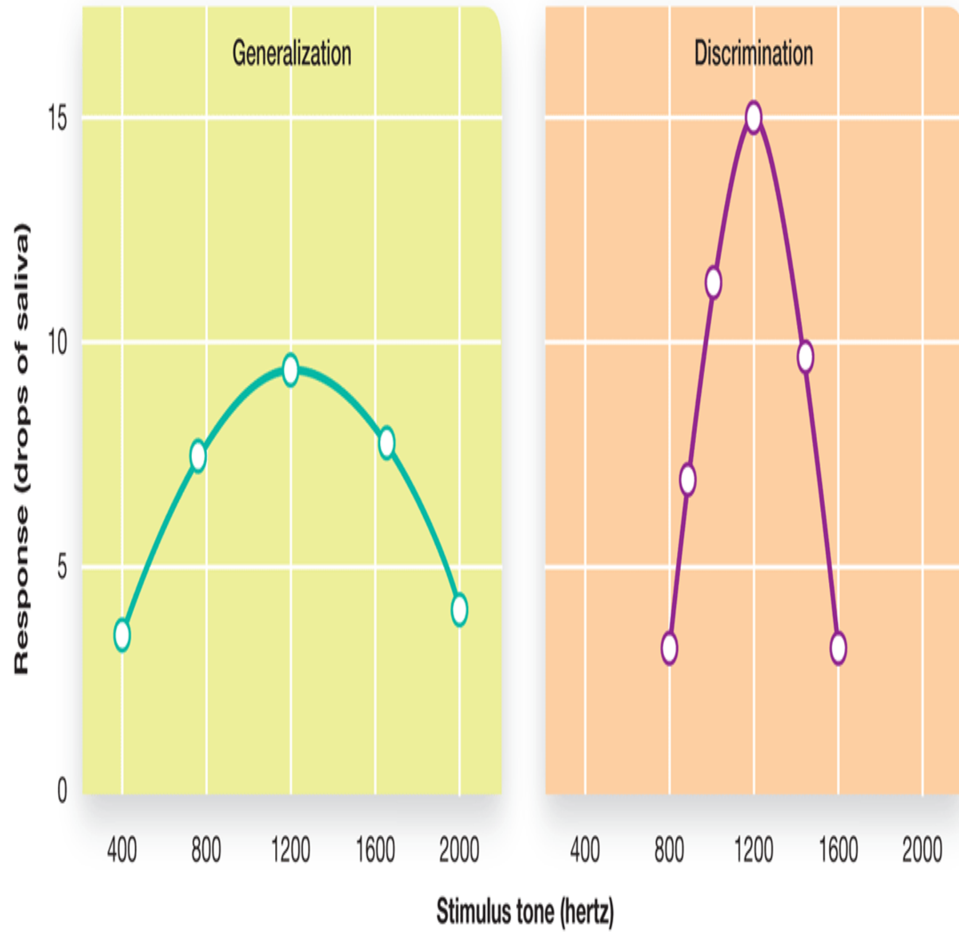
Extinction and spontaneous recovery are evidence that classically conditioned responses can change once they are acquired. Further evidence of flexibility of conditioned responding can be seen in some other processes of classical conditioning, including generalization and discrimination.

Stimulus Generalization and Discrimination

Listen to the Audio

Stimulus **generalization** *is a process in which a response that originally occurred for a specific stimulus also occurs for different, though similar, stimuli*. In Pavlov's experiment, dogs salivated not just to the original sound (CS), but also to very similar sounds (see Figure 6.5). At the cellular level, generalization may be explained, at least in part, by the Hebb rule discussed above. When we perceive a stimulus, it activates not only our brain's representation of that item, but also our representations of related items. Some of these additional representations (e.g., a sound that has a slightly higher or lower pitch than the conditioned stimulus) may become activated at the same time as the synapses involved in conditioned responses. If this did occur, according to the Hebb rule, the additional synapse would become strengthened and would therefore be more likely to fire along with the other cells in the future.

Figure 6.5 Stimulus Generalization and Discrimination



A conditioned response may generalize to other similar stimuli. In this case, salivation occurs not just for the 1200-Hz tone used during conditioning, but for other tones as well. Discrimination learning has occurred when responding is elicited by the original training stimulus, but much less so, if at all, for other stimuli.

Generalization allows for flexibility in learned behaviours, although it is certainly possible for behaviour to be *too* flexible. Salivating in response to *any* sound would be wasteful because not every sound correctly predicts food. Thus Pavlov's dogs also showed **discrimination**, *which occurs when an organism learns to respond to one original conditioned stimulus but not to new stimuli that may be similar to the original stimulus*. In salivary conditioning, the CS might be a 1200-hertz (Hz) tone, which is the only sound that is paired with food. The experimenter might produce tones of

1100 or 1300 Hz as well, but not pair these with food. This point is critical: If stimuli that are similar to the CS are presented *without* a US, then it becomes *less* likely that these stimuli will lead to stimulus generalization. Instead, these other tones would have their own memory representation in the brain—in which they did *not* receive food. So, stimulus discrimination would occur if salivation was triggered by the target 1200-Hz tone, but was not triggered (or was triggered less) in response to the other tones (Figure 6.5).

Applications of Classical Conditioning

Listen to the Audio

Now that you are familiar with the basic processes of classical conditioning, we can begin to explore its many applications. Classical conditioning is a common phenomenon that applies to many different situations, including emotional learning, aversions to certain foods, advertising, and responses to drugs.

Conditioned Emotional Responses

Listen to the Audio

Psychologists dating back to John Watson in the 1920s recognized that our emotional responses could be influenced by classical conditioning (Paul & Blumenthal, 1989; Watson & Rayner, 1920). These **conditioned emotional responses** *consist of emotional and physiological responses that develop to a specific object or situation*. In one of the most diabolical studies in the history of psychology, Watson and Rayner conditioned an 11-month-old child known as Albert B. (also referred to as "Little Albert") to fear white rats. When they first presented Albert with a white rat, he showed no fear, and even reached out for the animal. Later, while Albert was again in the vicinity of the rat, they startled him by striking a steel bar with a hammer. Watson and Rayner reported that Albert quickly associated the rat with the startling sound; the child soon showed a conditioned emotional response to the rat. In this situation, the US would be the loud noise. The UR would be the feeling of fear elicited by the loud noise. With repeated pairings of the loud noise and the white rat, the white rat—which preceded the onset of the loud noise—would start to trigger fear. In this case, the white rat became the CS and the fear it elicited became the CR. Little Albert not only developed a fear of rats; the emotional conditioning *generalized* to other white furry objects, including a rabbit and a Santa Claus mask.

It should be pointed out that ethical standards in modern-day psychological research would not allow this type of experiment to take place. To make matters worse, it appears that Watson and Rayner did not

keep in touch with Little Albert to see if there were any lasting effects from the study. In fact, the fate of Little Albert has been shrouded in mystery for almost a century. One group of researchers examined hospital records and reported that Little Albert passed away as a result of a brain illness (i.e., for reasons unrelated to this study) at the age of five (Beck et al., 2009; Fridlund et al., 2012). However, researchers at Grant MacEwan University in Edmonton found evidence suggesting that Little Albert actually lived a long and relatively happy life, although he was not comfortable around furry animals such as dogs (Digdon et al., 2014). More detective work is necessary to address these competing claims. Ironically, in 1928, Watson published a book entitled *Psychological Care of Infant and Child*.

The Watson and Rayner procedure may seem artificial because it took place in a laboratory, but here is a more naturalistic example. Consider a boy who sees his neighbour's cat. Not having a cat of his own, the child is very eager to pet the animal—perhaps a little too eager, because the cat reacts defensively and scratches his hand. The cat may become a CS for the boy, which elicits a fear response. Further, if generalization occurs, the boy might become afraid of all cats. Conditioned emotional responses like these offer a possible explanation for many phobias, which are intense, irrational fears of specific objects or situations (discussed in detail in Module 15.2).

During the past two decades, researchers have made great strides in identifying the brain regions responsible for such conditioned emotional responses. When an organism learns a fear-related association such as a tone predicting the onset of a startling noise, activity occurs in the amygdala, a brain area related to fear (Fanselow & Gale, 2003; Maren, 2001). If an organism learns to fear a particular location, such as learning that a certain cage is associated with an electrical shock, then context-related activity in the hippocampus will interact with fear-related activity

in the amygdala to produce *contextual fear conditioning* (Phillips & LeDoux, 1992). Importantly, the neural connections related to conditioned fear remain intact, even after extinction has occurred. Instead, other neurons suppress the activity of the brain areas related to the fear responses (Marek et al., 2013). If the CS is paired with the US again, this suppression will be removed and the fear-conditioned response will quickly reappear.

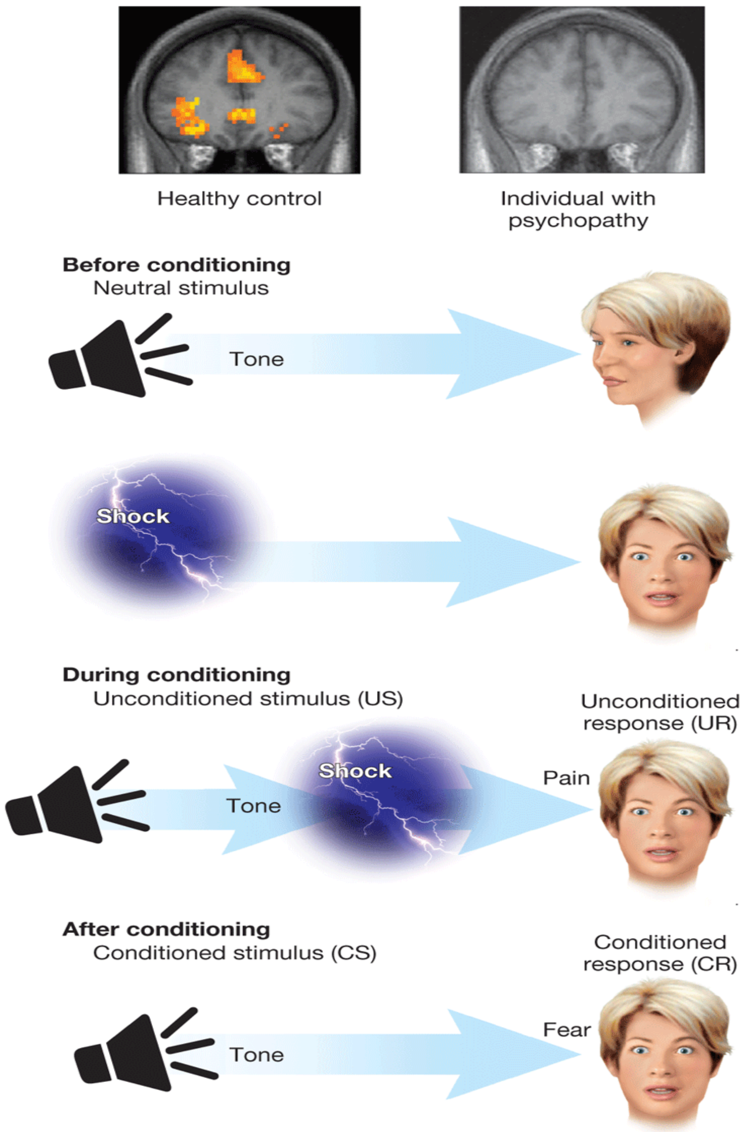
Watson and Rayner generalized Albert's fear of white rats to other furry, white objects. Shown here, Watson tests Albert's reaction to a Santa Claus mask.

Source: Archives of the History of American Psychology, The Center for the History of Psychology —The University of Akron.

Neuroimaging has been used to study the brain's responses to fear conditioning in both clinical populations and in healthy control

participants. For example, scientists have conducted some fascinating experiments on people diagnosed with psychopathy (the diagnosis of "psychopathy" is very similar to antisocial personality disorder; see Module 15.2). People with this disorder are notorious for disregarding the feelings of others. In one study, a sample of people diagnosed with psychopathy looked at brief presentations of human faces (neutral stimuli) followed by a painful stimulus (the US). The painful stimulus would obviously elicit a pain response (the UR). What *should* have happened is that over repeated pairings, participants would acquire a negative emotional reaction (the CR) to the faces (which are now the CS); but this particular sample did not react this way. Instead, these individuals showed very little physiological arousal, their emotional brain centres remained quiet, and overall they did not seem to mind looking at pictures of faces that had been paired with pain (see Figure 6.6; Birbaumer et al., 2005). In contrast, people who showed no signs of psychopathy did not enjoy this experience. In fact, following several pairings between CS and US, the control group showed increased physiological arousal and activity of the emotion centres of the brain, and understandably reported disliking the experience of the experiment.

Figure 6.6 Fear Conditioning and the Brain



During fear conditioning, a neutral stimulus (NS) such as a tone or a picture of a human face is briefly presented, followed by an unconditioned stimulus (US), such as a mild electric shock. The result is a conditioned fear response to the CS. A procedure like this has been used to compare fear responses in people diagnosed with psychopathy with control participants. The brain images show that those with psychopathy (top right image) showed very little response in their emotional brain circuitry when presented with the CS. In contrast, control participants showed strong activation in their emotional brain centres (top left image) (Birbaumer et al., 2005).

Source: Courtesy of Dr. Herta Flor.

Evolutionary Role for Fear Conditioning

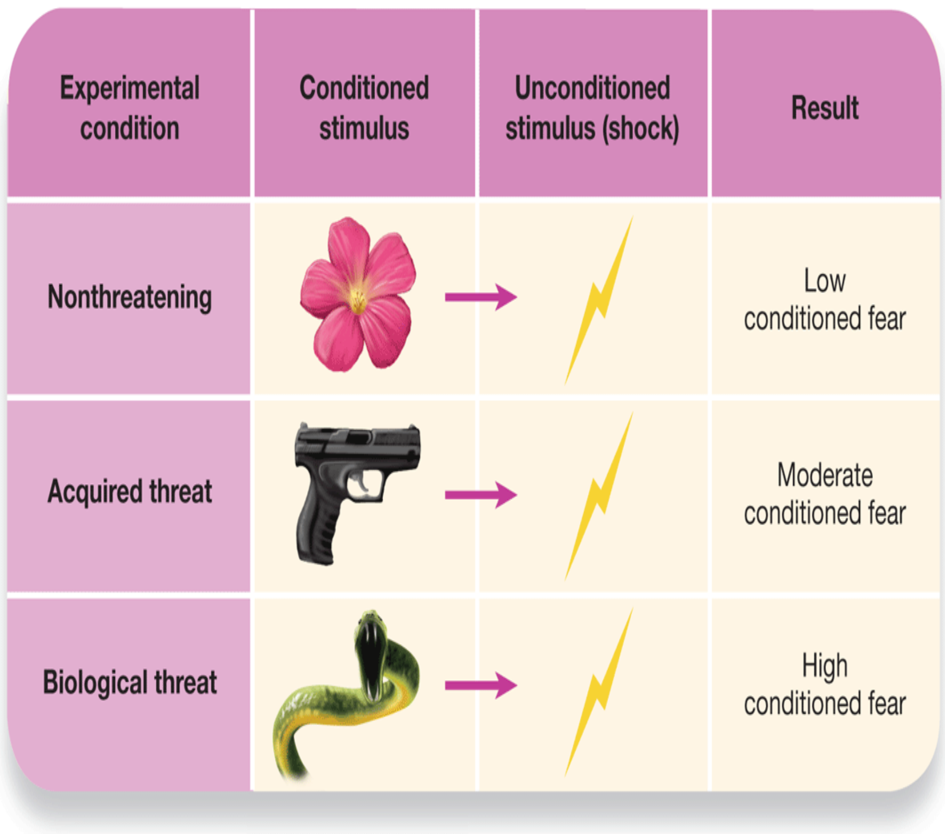
Listen to the Audio

A healthy fear response is important for survival, but not all situations or objects are equally dangerous. Snakes and heights probably elicit more fear and caution than butterflies or flowers. In fact, fearing snakes is very common, which makes it tempting to conclude that we have an *instinct* to fear them. In reality, young primates (e.g., both human children and young monkeys) tend to be quite curious about, or at least indifferent to, snakes, so this fear is most likely the product of learning rather than instinct.

Psychologists have conducted some ingenious experiments to address how learning is involved in fear of snakes. For instance, photographs of snakes (the CS) were paired with a mild electric shock (the US). One unconditioned response that a shock elicits is increased palm sweat—known as the skin conductance response. This reaction, part of the fight-or-flight response generated by the autonomic nervous system (Module 3.3), occurs when our bodies are aroused by a threatening or uncomfortable stimulus. Following several pairings between snake photos and shock in an experimental setting, the snake photos alone (the CS) elicited a strong increase in skin conductance response (the CR). For comparison, participants were also shown non-threatening pictures of flowers, paired with the shock. Much less intense conditioned responding developed in response to the pictures of flowers, even though the pictures had been paired with the shock just as many times as the snake pictures had been paired with the shock (Figure 6.7; Öhman & Mineka, 2001).

Thus, it appears we are predisposed to acquire a fear of snakes, but not of flowers.

Figure 6.7 Biologically Prepared Fear



Physiological measures of fear are highest in response to photos of snakes after the photos are paired with an electric shock—even higher than the responses to photos of guns. Flowers—something that humans generally do not need to fear in nature—are least effective when it comes to conditioning fear responses.

This finding may not be too surprising, but what about other potentially dangerous objects such as guns? In many regions of the world, guns are far more often associated with death or injury than snakes and certainly flowers. When the researchers paired pictures of guns (the CS) with the shock (US), they found that conditioned arousal to guns among

participants was less than that to snake photos, and comparable to that of harmless flowers. In addition, the conditioned arousal to snake photos proved longer lasting and slower to extinguish than the conditioned responding to pictures of guns or flowers (Öhman & Mineka, 2001). However, before completely accepting this finding it should be noted that work on the rapid learning of snake fear has not always been replicated in different laboratories, and snakes are simply perceived more rapidly in the visual system than other threats, and therefore capture our attention more quickly than stimuli such as guns or flowers (Burghardt & Bowers, 2017; Isbell, 2006). These caveats aside, given that guns and snakes both have the potential to be dangerous, why is it so much easier to learn a fear of snakes than a fear of guns? One possibility is that over time, humans have evolved a strong predisposition to detect and fear an animal that has a long history of causing severe injury or death (Cook et al., 1986; Öhman & Mineka, 2001). The survival advantage has gone to those who quickly avoided animals such as snakes. The same is not true for flowers (which do not attack humans) or guns (which are relatively new in our species' history). This evolutionary explanation is known as **preparedness**, *the biological predisposition to rapidly learn a response to a particular class of stimuli* (Seligman, 1971).

Conditioned Taste Aversions

Listen to the Audio

Another example of an evolutionarily useful conditioned fear response comes from food aversions. Chances are there is a food that you cannot stand to even look at because it once made you ill. This new aversion isn't due to chance; rather, your brain and body have linked the taste, sight, and smell of that food to the feeling of nausea. In this situation, the taste (and often the sight and smell) of the food or fluid serves as the CS. The US is whatever substance in the food or environment happened to make you sick (e.g., some sort of bacteria); this, in turn, leads to the actual sickness (the UR). Aversion is not simply a case of "feeling gross." Instead, it involves both a feeling (and in some species, a facial expression) of disgust *and* a withdrawal or avoidance response. When the CS and US are linked, the taste of the food or fluid soon produces aversion responses (the CR), even in the absence of physical illness (see Figure 6.8). This *acquired dislike or disgust for a food or drink because it was paired with illness* is known as **conditioned taste aversion** (Garcia et al., 1966).

Figure 6.8 Conditioned Taste Aversion

Classical conditioning can account for the development of taste aversions.

1 of 3

Previous

Next

Conditioned taste aversions may develop in a variety of ways, such as through illness associated with food poisoning, the flu, medical procedures, or excessive intoxication. Importantly, these conditioned aversions only occur for the flavour of a particular food rather than to other stimuli that may have been present when you became ill. For example, if you were listening to a particular song while you got sick from eating tainted spinach or a two-week-old tuna sandwich, your aversion would develop to the taste of spinach, but not to the song that was playing. Thus, humans (and many other animals) are biologically prepared to associate food, but not sound, with illness (Garcia et al., 1966).

The phenomenon of conditioned taste aversions presents some puzzling observations. For instance, the onset of symptoms from food poisoning may not occur until several hours have passed after the tainted food or beverage was consumed. As a consequence, the interval between tasting the food (CS) and feeling sick (UR) may be a matter of hours, whereas most conditioning happens only if the CS, US, and the UR occur very

closely to each other in time. Another peculiarity is that taste aversions are learned very quickly—a single CS–US pairing leading to illness is typically sufficient. These special characteristics of taste aversions are extremely important for survival. The flexibility offered by a long window of time separating food (CS) and the illness (UR), as well as the requirement for only a single exposure, raises the chances of acquiring an important aversion to the offending substance.

One potential explanation for these characteristics involves the food stimuli themselves. Usually, a conditioned taste aversion develops to something we have ingested that has an unfamiliar flavour. Such flavours stick out when they are experienced for the first time and are therefore much easier to remember, even after considerable time has passed. In contrast, if you have eaten the same ham and Swiss cheese sandwich at lunch for years, and you become ill one afternoon after eating it, you will be less prone to develop a conditioned taste aversion. This scenario can be explained by **latent inhibition**, *which occurs when frequent experience with a stimulus before it is paired with a US makes it less likely that conditioning will occur after a single episode of illness* (Lubow & Moore, 1959).

Conditioned taste aversions are a naturally occurring experience. However, conditioned emotional responses are also being created by advertisers to influence our responses. As you will read in the next section, food is not the only stimulus that can make you feel sick.

Working the Scientific Literacy Model

Conditioning and Negative Political Advertising

Listen to the Audio

Some politicians have charisma; you want to like them and believe what they say. Barack Obama (U.S. president from 2009 to 2017) was treated like a rock star when he travelled internationally (and still is). Justin Trudeau (Canadian prime minister from 2016) has also received a lot of positive attention, particularly at the beginning of his time as prime minister. But not everyone has natural charisma. In these cases, politicians need to use advertising and carefully constructed "photo ops" to create emotional responses that can influence voting behaviours. In an ideal world, these advertisements would focus on issues and would highlight the candidates' positive qualities. Unfortunately, the past few decades have seen a dramatic upsurge in a different form of advertising: negative attack ads. The highly contentious 2016 U.S. presidential campaign between Hillary Clinton and Donald Trump witnessed more negative attack ads than recorded during election cycles spanning 1952 to 2001. Sixty-six percent of pro-Clinton ads and 75% of pro-Trump ads were negative or attack oriented. Within those totals, 61% of pro-Clinton ads and 47% of pro-Trump ads were character attacks of the opponent (Tedesco & Dunn, 2018). These numbers do not include the content of free media such as Twitter, which

has become a particularly popular venue for political bullying by Trump.

This type of advertisement relies on the principles of classical conditioning and, in the process, treats you, the voter, like one of Pavlov's dogs.

What do we know about classical conditioning in negative political advertising?

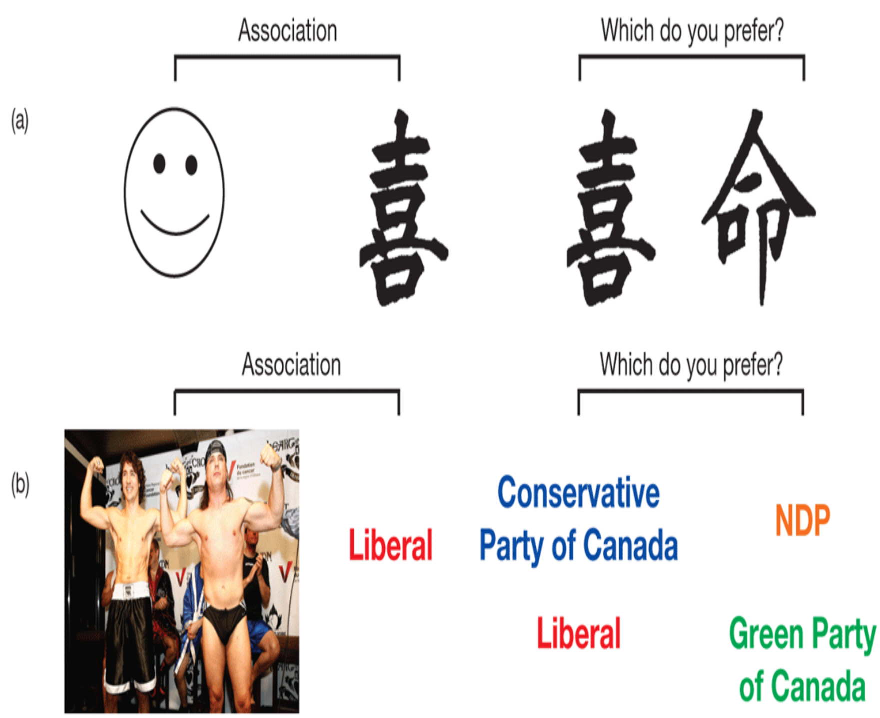
Negative political advertisements routinely include unflattering images. In the next federal or provincial election, pay attention to the commercials that are sponsored by each party and you will notice a few tricks. First, many images of opponents will be black and white and of poor quality (grainy). This trick is designed to make viewers feel mildly frustrated when viewing the unclear photographs. Second, the images of the attacked politicians will include them expressing a negative emotion. In some, they will be yelling (angry faces trigger a physiological response in people). Others may show facial expressions that appear smug or that suggest the candidate feels contempt toward the person they're looking at (which, in this case, would appear to be *you*). The assumption underlying these attack ads is that if you pair a party leader with imagery that generates unpleasant emotions, then viewers will associate that leader with negative feelings and be less likely to vote for that party.

In this case, the CS would be the attacked politician. The US would be the negative imagery. The UR would be the negative emotional response to the imagery (or unflattering photograph). Eventually, the individuals who constructed the ad hope that simply seeing the attacked person will produce a negative emotional response (CR) along with the thought, "I will not vote for him or her." The question is, "Does this work?"

How can science help explain the role of classical conditioning in negative political advertising?

An attempt to use negative emotions to alter people's opinions of political candidates is similar to a psychology research technique known as *evaluative conditioning*. In an evaluative conditioning study, experimenters pair a stimulus (e.g., a shape) with either positive or negative stimuli (e.g., an angry face; Murphy & Zajonc, 1993). The repeated association of a stimulus with an emotion leads participants to develop a positive or negative feeling toward that stimulus (depending on the emotional pairing; see Figure 6.9). This is precisely what political strategists are attempting to do when they show unpleasant pictures of an opponent and pair it with angry narrators and emotional labels.

Figure 6.9 Evaluative Conditioning



In evaluative conditioning, researchers pair an emotional image (e.g., an emotional face) with a previously neutral target image

such as a Japanese symbol. The association that (sometimes) forms between the two images can influence participants' later judgments of the target image, leading them to like (if paired with a happy face) or dislike (if paired with angry face) them more than if no conditioning had occurred. Political advertising sometimes uses similar, if less subtle, techniques.

REUTERS/Alamy Stock Photo

In the laboratory, evaluative conditioning works. This phenomenon has been found with visual, auditory, olfactory (smell), taste, and tactile (touch) stimuli. It has been used to alter feelings toward objects ranging from snack foods (Lebens et al., 2011), to consumer brands (Walther & Grigoriadis, 2004), to novel shapes (Olson & Fazio, 2001). A number of studies have specifically attempted to use conditioning to create negative attitudes toward products or behaviours (Moore et al., 1982; Zanna et al., 1970), a goal similar to the attack ads you see each election. For instance, Stuart and colleagues (1990) found that associating a new brand of toothpaste with negative pictures decreased evaluations of that product. In all of these cases, the advertisers and sponsoring politicians are assuming that the viewer will associate the negative emotions (UR) with the ad's target (CS) and that this will make the viewer more likely to select an alternative (i.e., the candidate sponsoring the attack ad). In the case of politics, this assumption makes sense—attack ads tend to be effective and are recalled better than other types of political information (Fernandes, 2013).

Can we critically evaluate this information?

A major question that arises from this research is whether producing a negative opinion of one option (be it a brand of toothpaste or a political candidate) automatically means that you also produce a positive opinion of the other option. Oftentimes,

we can't tell if the results are due to liking one option or disliking the other option. This question isn't really an issue for U.S.-based studies, as there are only two parties in that country (for now). However, with five political parties running in the next federal election in Canada, there is a danger that attack ads might produce negative opinions of the target, but still not boost opinions of the party running the ads.

Recent research has examined who is actually influenced by these attack ads. In one U.S.-based study (none have been conducted in Canada), researchers found that negative ads had no effect on donations to political parties. They did, however, increase voter turnout among *partisans*, people who already agreed with the views expressed in the ads (Barton et al., 2016). In other words, although the primary goal of attack ads might be to make undecided voters associate negative emotions with the target of the ads, the actual effect of the ads is to motivate people who already had negative emotions to *act* on those emotions (i.e., to vote).

Why is this relevant?

Dozens of studies indicate that people are prone to a *third-person effect* whereby they assume that other people are more affected by advertising and mass media messages than they themselves are (Cheng & Riffe, 2008; Perloff, 2002). Thus, there appears to be a disconnect between the power of negative advertising and people's awareness of its effects. It is important to realize that conditioning often occurs without our conscious awareness. Our brains are designed to make associations. So, by becoming aware of how marketing companies and politicians are using classical conditioning to influence how you vote, you can try to reduce the effect of their manipulation. That way, when you cast your vote,

it will hopefully be because of issues you care about and not because of conditioned emotional responses.

Evaluative conditioning occurs in other realms of social behaviour as well. For example, people develop stronger negative conditioned responses to members of other racial groups than to their own group. Researchers presented white and Black people with pictures of individuals of these two racial groups paired with a mild electric shock (enough to be experienced as unpleasant, but not painful). Following pairing pictures of both groups with shock, the participants showed higher physiological arousal when viewing pictures of their racial "outgroup" in comparison to pictures of their "in group" (Olsson et al., 2005). Negative evaluations of others can be difficult to overcome. In a laboratory study, participants were conditioned to classify people presented in photos as either cooperators or cheaters. These learned associations were hard to overcome. Researchers asked participants to disregard the negative associations formed toward some of the cheaters (e.g., "Sorry, my mistake, those people are actually trustworthy"). Despite attempts to extinguish the negative associations, participants still rated these people as less trustworthy than people who were regarded as cooperators all along (Suzuki et al., 2013).

Drug Tolerance and Conditioning

Listen to the Audio

In addition to influencing overt behaviours such as salivating and emotional behaviours such as phobias, classical conditioning can influence how the body regulates its own responses to different stimuli. For example, classical conditioning can help explain some drug-related phenomena, such as cravings and tolerance. Cues that accompany drug use can become conditioned stimuli that elicit cravings (Sinha, 2009). For example, a cigarette lighter, the smell of tobacco smoke, or the presence of another smoker can elicit cravings in people who smoke.

Conditioning can also influence drug tolerance, or a decreased reaction that occurs with repeated use of the drug (Siegel et al., 2000). When a person takes a drug, his or her body attempts to metabolize that substance. Over time, the setting and paraphernalia associated with the drug-taking begin to serve as cues (a CS) that a drug (US) will soon be processed by the body (UR). As a result of this association, the physiological processes involved with metabolizing the drug will begin with the appearance of the CS rather than when the drug is actually consumed. In other words, because of conditioning, the body is already braced for the drug before the drug has been snorted, smoked, or injected. This response means that, over time, more of the drug will be needed to override these preparatory responses so that the desired effect can be obtained; this change is referred to as *conditioned drug tolerance*.

This phenomenon can have fatal consequences for drug abusers. Shepard Siegel (1984; 2016), a psychologist at McMaster University, conducted interviews with patients who were hospitalized for overdosing on heroin. Over the course of his interviews, a pattern among the patients emerged. Several individuals reported that they were in situations unlike those that typically preceded their heroin injections—for example, in a different environment or even using an injection site (i.e., part of the body) that differed from the usual ritual. As a result of these differences, there were fewer CSs present to trigger the CR, the body's metabolizing activity that braced (or prepared) the drug taker's body for the arrival of the drug. Without this conditioned preparatory response, delivery of even a *normal* dose of the drug can be lethal. This finding has been confirmed in animal studies: Siegel and his associates (1982) found that conditioned drug tolerance and overdosing can also occur with rats. When rats received heroin in an environment different from where they experienced the drug previously, mortality rates were double that of control rats that received the same dose of heroin in their normal surroundings (64% versus 32%).

The examples discussed in this module are only a few of the applications of classical conditioning (Domjan et al., 2004). But the fact that behaviours ranging from phobias, to voting preferences, to drug tolerance can be explained by classical conditioning shows us that Pavlov's observations of his salivating dogs were really just a drop in the bucket.

Module 6.1 Summary

Listen to the Audio

6.1a Know . . . the key terminology involved in classical conditioning.

Review Module 6.1

Start Over Swap

0/13 REVIEWED · 0 MASTERED

preparedness

Previous Next Got It!

6.1b Understand . . . how responses learned through classical conditioning can be acquired and lost.

Acquisition of a conditioned response occurs with repeated pairings of the CS and the US. Once a response is acquired, it can be extinguished if

the CS and the US no longer occur together. During extinction, the CR diminishes, although it may reappear under some circumstances. For example, if enough time passes following extinction, the CR may spontaneously recover when the organism encounters the CS again.

6.1c Understand . . . the role of biological and evolutionary factors in classical conditioning.

Conditioned responses such as salivating to food and freezing in response to threats prepare organisms to interact with the unconditioned stimulus, which is biologically relevant and may either enhance or jeopardize survival. Furthermore, not all stimuli have the same potential to become a strong CS. Responses to biologically relevant stimuli, such as snakes, can be more easily conditioned than responses to stimuli such as flowers or guns, for example. Similarly, avoidance of potentially harmful foods is critical to survival, so organisms can develop a conditioned taste aversion quickly (in a single trial) and even when ingestion and illness are separated by a relatively long time interval.

6.1d Apply . . . the concepts and terms of classical conditioning to new examples.

Apply Activity

Read the three scenarios that follow and identify the conditioned stimulus (CS), the unconditioned stimulus (US), the conditioned response (CR), and the unconditioned response (UR) in each case. (*Hint:* When you apply the terms CS, US, CR, and UR, a good strategy is to identify whether something is a stimulus (something that elicits) or a response (a behaviour). Next, identify whether the stimulus automatically elicits a response (the US) or does so only after being paired with a US (a CS).

Finally, identify whether the response occurs in response to the US alone (the UR) or the CS alone (the CR).)

1. Cameron and Tia went to the prom together. During their last slow dance, the DJ played the theme song for the event. During the song, the couple kissed. Now, several years later, whenever Cameron and Tia hear the song, they feel a rush of excitement.
2. Harry has visited his eye doctor several times due to problems with his vision. One test involves blowing a puff of air into his eye. After repeated visits to the eye doctor, Harry starts blinking as soon as the doctor begins to prepare the instrument.
3. Sarah went to a new restaurant and experienced the most delicious meal she had ever tasted. The restaurant began advertising on the radio, and now every time an ad comes on, Sarah finds herself craving the meal she enjoyed so much.

6.1e Analyze . . . the use of negative political advertising to condition emotional responses to candidates.

Negative political advertising often uses a form of conditioning known as evaluative conditioning. Negative images, sounds, and/or statements are paired with images of the targeted candidate. The goal is to have viewers link negative emotions with the target. Research has found that this technique can be successful. But if the images used are deemed cruel or inappropriate, it is possible that viewers will feel negative emotions toward the sponsor of the ad instead.

Module 6.2 Operant Conditioning: Learning through Consequences

Listen to the Audio

Mike Mergen/Bloomberg via Getty Images

Learning Objectives

6.2a Know . . . the key terminology associated with operant conditioning.

6.2b Understand . . . the role that consequences play in increasing or decreasing behaviour.

6.2c Understand . . . how schedules of reinforcement affect behaviour.

6.2d Apply . . . your knowledge of operant conditioning to examples.

6.2e Analyze . . . the effectiveness of punishment on changing behaviour.

Gambling is a multibillion-dollar industry in Canada. Given the huge sum that Canadians spend on gambling, it is clear that some individuals are spending more than they should on this habit. Psychologists and government officials have invested a considerable amount of time into the development of prevention and treatment programs for gambling addictions. Although these programs have led to addiction rates levelling off in recent years, compulsive gambling is still a problem in Canada. So, what compels people to keep pulling the lever on a slot machine or pressing buttons on a VLT (video lottery terminal) screen when logic would tell them to stop and go home?

Although the answer to this question is complicated (Hodgins et al., 2011), it is clear that reinforcement plays a role in these behaviours. As you will read in this module, rewarding a behaviour—which happens when someone wins money after pressing the button on a VLT—makes that behaviour more likely to occur again in the future. The effect is larger when the reward doesn't happen every time and isn't predictable—qualities that perfectly describe gambling. The machines aren't the only ones having their buttons pushed.

Very few of our behaviours are random. Instead, people tend to repeat actions that previously led to positive or rewarding outcomes. If you go to a new restaurant and like it, you will eat there again. Conversely, if a behaviour previously led to a negative outcome, people are less likely to perform that action again. If you go to a new restaurant and don't enjoy the meal, then you will likely not eat there again. This type of stimulus-response learning is known as **operant conditioning**, *a type of learning in which behaviour is influenced by consequences*. The term *operant* is used because the individual *operates* on the environment before consequences can occur. In contrast to classical conditioning, which typically affects *reflexive* responses, operant conditioning involves *voluntary* actions such as speaking or listening, starting and stopping an activity, and moving toward or away from something. Whether and when we engage in these types of behaviours depend on how our unique collection of previous experiences has influenced what we do and do not find rewarding.

Initially, the difference between classical and operant conditioning may seem unclear. One useful way of telling the difference is that in classical conditioning a response is *not* required for a reward (or unconditioned stimulus) to be presented; to return to Pavlov's dogs, meat powder was presented regardless of whether salivation occurred. In classical conditioning, learning has taken place if a conditioned response develops following pairings of the conditioned stimulus and the unconditioned stimulus. In other words, the dogs learned the association between the sound of a metronome and food (as shown by their salivation), but they didn't have to actually *do* anything. In operant conditioning, a response and a consequence are required for learning to take place. Without a response of some kind, there can be no consequence. See Table 6.1 for a summary of differences between operant and classical conditioning.

Table 6.1 Major Differences between Classical and Operant Conditioning

Table 6.1 Major Differences between Classical and Operant Conditioning

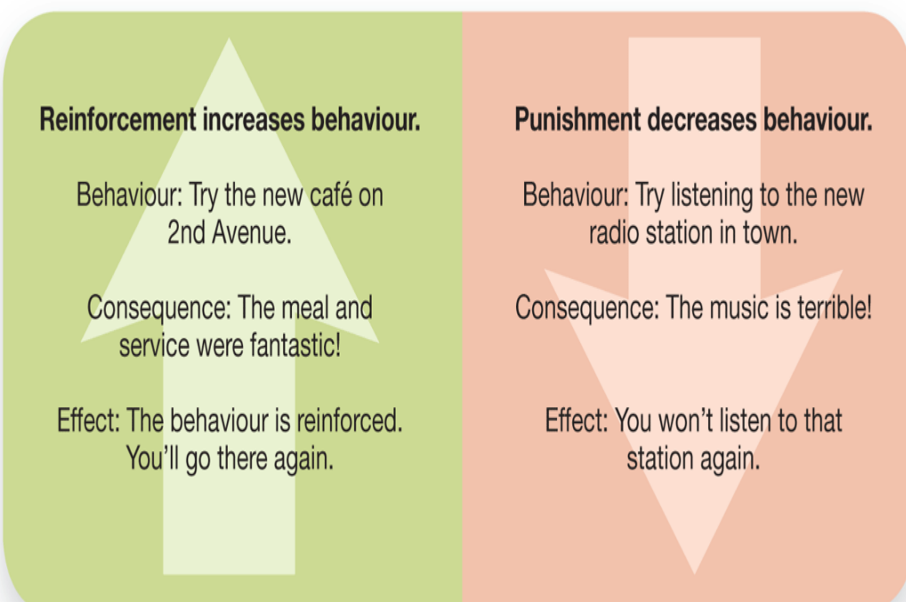
	Classical Conditioning	Operant Conditioning
Target response is . . .	Automatic	Voluntary
Reinforcement is . . .	Present regardless of whether a response occurs	A consequence of the behaviour
Behaviour mostly depends on . . .	Reflexive and physiological responses	Skeletal muscles

Basic Principles of Operant Conditioning

Listen to the Audio

The concept of *contingency* is important to understanding operant conditioning; it simply means that a consequence depends upon an action. Earning good grades is generally contingent upon studying effectively. Excelling at athletics is contingent upon training and practice. The consequences of a particular behaviour can be either reinforcing or punishing (see Figure 6.10).

Figure 6.10 Reinforcement and Punishment



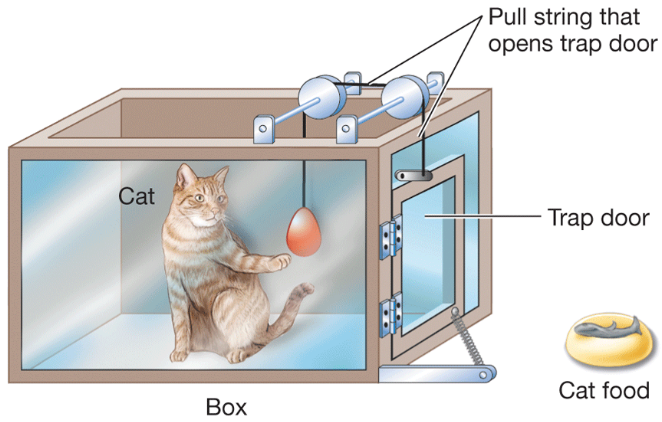
The key distinction between reinforcement and punishment is that reinforcers, no matter what they are, increase behaviour. Punishment involves a decrease in behaviour, regardless of what the specific punisher may be. Thus both reinforcement and punishment are defined based on their effects on behaviour.

Reinforcement and Punishment

Listen to the Audio

Reinforcement *is a process in which an event or reward that follows a response increases the likelihood of that response occurring again*. We can trace the scientific study of reinforcement's effects on behaviour back to Edward Thorndike, who conducted experiments in which he measured the time it took cats to learn how to escape from puzzle boxes (see Figure 6.11). Thorndike (1905) observed that over repeated trials, cats were able to escape more rapidly because they learned which responses worked (such as pressing a pedal on the floor of the box). From his experiments, Thorndike proposed the **law of effect**—*the idea that responses followed by satisfaction will occur again in the same situation, whereas those that are not followed by satisfaction become less likely*. In this definition, "satisfaction" implies either that the animal's desired goal was achieved (e.g., escaping the puzzle box) or it received some form of reward for the behaviour (e.g., food).

Figure 6.11 Thorndike's Puzzle Box and the Law of Effect



(a)

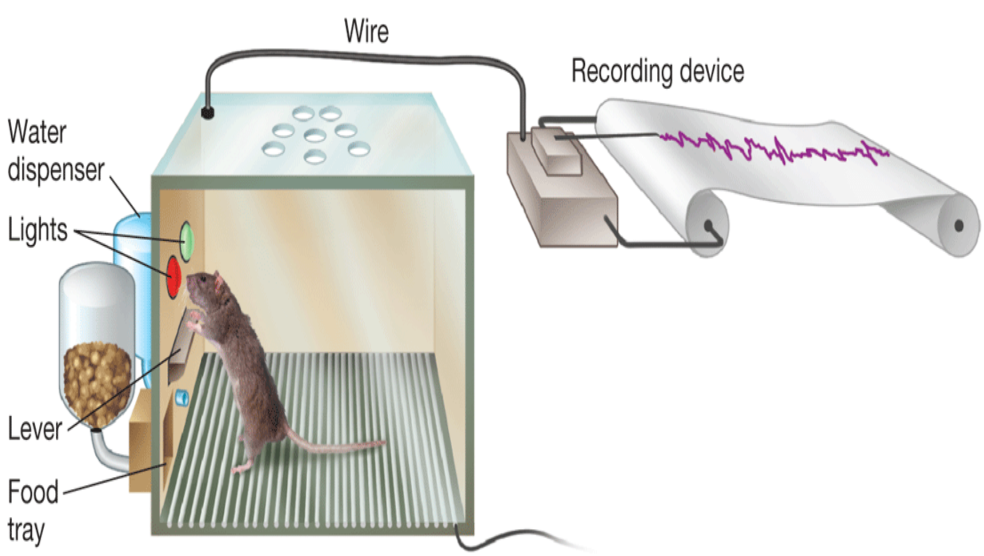
(b)

(a) Thorndike conducted experiments in which cats learned an operant response that was reinforced with escape from the box and access to a food reward. (b) Over repeated trials, the cats took progressively less time to escape, as shown in this learning curve.

Within a few decades of the publication of Thorndike's work, the famous behaviourist B. F. Skinner began conducting his own studies on the systematic relationship between reinforcement and behaviour. Although operant conditioning can explain many human behaviours, most of its basic principles stem from laboratory studies conducted on nonhuman species such as pigeons or rats, which were placed in an apparatus such as the one pictured in Figure 6.12. These *operant chambers*, sometimes

referred to as *Skinner boxes*, include a lever or key that the subject can manipulate. Pushing the lever may result in the delivery of a reinforcer such as food. In operant conditioning terms, a **reinforcer** *is a stimulus that is contingent upon a response and that increases the probability of that response occurring again*. (So, a reinforcer would be a stimulus like food, whereas reinforcement would be the changes in the frequency of a behaviour like lever pressing that occur *as a result of* the food reward.) Researchers use machinery such as operant chambers to help them control and quantify learning. Specifically, researchers record an animal's rate of responding over time (a measure of learning), and typically set a criterion for the number of responses that must be made before a reinforcer becomes available. As you will read later in this module, animals and humans are quite sensitive to how many responses they must make, or how long they must wait, in order to receive a reward.

Figure 6.12 An Operant Chamber



The operant chamber is a standard laboratory apparatus for studying operant conditioning. The rat can press the lever to receive a reinforcer such as food or water. The lights can be used to indicate when lever pressing will be rewarded. The recording device measures cumulative responses (lever presses) over time.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed., © 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

The discussion thus far has focused on how reinforcement can lead to increased responding; but decreased responding is also a possible outcome of an encounter with a stimulus. **Punishment** *is a process that decreases the future probability of a response*. Thus, a **punisher** *is a stimulus that is contingent upon a response, and that results in a decrease in behaviour*. Like reinforcers, punishers are defined not based on the stimuli themselves, but rather on their effects on behaviour. In all cases, a punisher—be it yelling, losing money, or going to jail—will make it less likely that a particular response will occur again.

Positive and Negative Reinforcement and Punishment

Listen to the Audio

Thus far, we have differentiated between reinforcement (when a response increases the likelihood that a behaviour will occur again) and punishment (when a response decreases the likelihood that a behaviour will occur again). In both of these cases, it is natural to think of the responses as something that is added to the situation. For instance, a behaviour could be reinforced by giving the animal food. Or, it could be punished by shocking the animal. But both reinforcement and punishment can be accomplished by *removing* a stimulus as well. In the descriptions that follow, try to remember the following four terms as they are used in operant conditioning:

- Reinforcement: this *increases* the chances of a behaviour occurring again
- Punishment: this *decreases* the chances of a behaviour occurring again
- Positive: this means that a stimulus is *added* to a situation; positive can refer to reinforcement or punishment
- Negative: this means that a stimulus is *removed* from a situation; negative can refer to reinforcement or punishment

These terms can be combined to produce four different subtypes of operant conditioning. For instance, a response can be strengthened because it brings a reward. This form of reinforcement, **positive reinforcement**, *is the strengthening of behaviour after potential reinforcers*

such as praise, money, or nourishment follow that behaviour (see Table 6.2). For example, if you laugh at your professor's jokes, the praise will serve as a reward; this will increase the likelihood that your professor will tell more jokes. (Remember: the "positive" in positive reinforcement indicates the *addition* of a reward.) Positive reinforcement can be a highly effective method of rewarding desired behaviours among humans and other species.

Table 6.2 Distinguishing Types of Reinforcement and Punishment

Table 6.2 Distinguishing Types of Reinforcement and Punishment

	Consequence	Effect on Behaviour	Example
Positive reinforcement	Stimulus is added or increased.	Increases the response	A child gets an allowance for making their bed, so they are likely to do it again in the future.
Negative reinforcement	Stimulus is removed or decreased.	Increases the response	The rain no longer falls on you after opening your umbrella, so you are likely to do it again in the future.
Positive punishment	Stimulus is added or increased.	Decreases the response	A pet owner scolds their dog for jumping up on a house guest, and now the dog is less likely to do it again.
Negative punishment	Stimulus is removed or decreased.	Decreases the response	A parent takes away TV privileges to stop the children from fighting.

Behaviour can also be reinforced by the removal of something that is unpleasant. This form of reinforcement, **negative reinforcement**, *involves the strengthening of a behaviour because it removes or diminishes a stimulus* (Table 6.2). For instance, taking aspirin is negatively reinforced because doing so removes a painful headache. Similarly, studying in order to prevent nagging from parents is also a form of reinforcement as the behaviour, studying, will increase.

Negative reinforcement is a concept that students frequently find confusing because it seems unusual that something aversive could be involved in the context of reinforcement. Recall that reinforcement (whether positive or negative) always involves an increase in the strength or frequency of responding. Also remember that the term *positive* in this context simply means that a stimulus is introduced or increased, whereas the term *negative* means that a stimulus has been reduced or avoided.

But not all types of negative reinforcement are the same; in fact, negative reinforcement can be further classified into two subcategories. **Avoidance learning** *is a specific type of negative reinforcement that removes the possibility that a stimulus will occur*. Examples of avoidance learning include leaving a sporting event early to avoid crowds and traffic congestion, and paying bills on time to avoid late fees. In these cases, negative situations are avoided. **Escape learning**, on the other hand, *occurs if a response removes a stimulus that is already present*. Covering your ears upon hearing overwhelmingly loud music is one example. You cannot avoid the music, because it is already present, so you perform a specific behaviour (covering your ears) to escape the aversive stimulus instead. The responses of paying bills on time to avoid late fees and covering your ears to escape loud music both increase in frequency because they have effectively prevented or removed the aversive stimuli.

In the laboratory, operant chambers such as the one pictured in Figure 6.12 often come equipped with a grid metal floor that can be used to deliver a mild electric shock; responses that remove (escape learning) or prevent (avoidance learning) the shock are negatively reinforced. This highly controlled environment allows researchers to carefully monitor all aspects of an animal’s environment while investigating the different contingencies that will cause a behaviour to increase or decrease in frequency.

As with reinforcement, various types of punishment are possible. **Positive punishment** *is a process in which a behaviour decreases in frequency because it was followed by a particular, usually unpleasant, stimulus* (Table 6.2). For example, some cat owners use a spray bottle to squirt water when the cat hops on the kitchen counter or scratches the furniture. Remember that the term *positive* simply means that a stimulus is added to the situation (i.e., no one is claiming that spraying a cat with water is an emotionally positive experience). In these cases, the stimuli are punishers because they decrease the frequency of a behaviour.

Finally, **negative punishment** *occurs when a behaviour decreases because it removes or diminishes a particular stimulus* (Table 6.2). Withholding someone's privileges as a result of an undesirable behaviour is an example of negative punishment. A parent who "grounds" a child does so because this action removes something of value to the child. If effective, the outcome of the grounding will be to decrease the behaviour that got the child into trouble.

Review Applying Reinforcement and Punishment

Match the punishment or reinforcement type to the scenario described.

Scenario	Process
Julius continuously pesters his sister while she is trying to watch TV. His father insists that Julius spends 15 minutes in his room each time he pesters her. Julius subsequently stops bothering his sister.	negative punishment
Sabrina wants to prevent her cat from eating the plants. Each time the cat jumps on the table and starts to chew on some leaves Sabrina squirts water on her cat's face. Which process is Sabrina using to control the cat's behaviour?	positive punishment
Cheyenne's drive to work and home usually only takes 10 minutes, but one day she was caught in construction and it took 20 minutes longer. Cheyenne now takes an alternative route every day. Which process accounts for Cheyenne's change in behaviour?	negative reinforcement
Laura has multiple exams to prepare for. Over the weekend she allows herself to stream one episode of her favourite program for every 2 hours she studies. Which process is Laura using to encourage studying?	positive reinforcement

Check Your Understanding

Shaping

Listen to the Audio

Although these different forms of reinforcement and punishment make sense in theory, researchers (and parents) have an additional challenge: How do you get animals (or children) to perform the behaviour that you want to reinforce? Rats placed in operant chambers do not automatically go straight for the lever and begin pressing it to obtain food rewards. Instead, they must first learn that lever pressing accomplishes something. Getting a rat to press a lever can be done by reinforcing behaviours that *approximate* (or lead up to) lever pressing, such as standing up, facing the lever, standing while facing the lever, placing paws upon the lever, and pressing downward. This process of *reinforcing successive approximations of a specific operant response* is known as **shaping**. Shaping is done in a step-by-step fashion until the desired response—in this case, lever pressing—is learned. These techniques can also be used to help people develop specific skill sets (e.g., toilet training). A similar process, **chaining**, *involves linking together two or more shaped behaviours into a more complex action or sequence of actions*. When you see an animal "acting" in a movie, its behaviours were almost certainly learned through lengthy shaping and chaining procedures.

Applications of shaping. Reinforcement can be used to shape complex chains of behaviour in animals and humans. (Later attempts to teach the cat to use a bidet were less successful.)

Bork/Shutterstock

Applying Operant Conditioning

Listen to the Audio

It is important to remember that although most studies of operant learning have involved animals, the principles derived from these studies apply to humans as well. In fact, they are found in many different areas of our lives ranging from work and school to interpersonal relationships. For example, the operant conditioning principles that we've reviewed thus far serve as the basis for an educational method called **applied behaviour analysis** (ABA), *which involves using close observation, prompting, and reinforcement to teach behaviours, often to people who experience difficulties and challenges owing to a developmental condition such as autism* (Granpeesheh et al., 2009). People with autism are typically non-responsive to normal social cues from a very early age. This impairment can lead to a deficit in developing many skills, ranging from basic, everyday ones to complex skills such as language. For example, explaining how to clear dishes from the dinner table to a child with autism could prove difficult. Psychologists who specialize in ABA often shape the desired behaviour using prompts (such as asking the child to stand up, gather silverware, stack plates, and so on) and verbal rewards as each step is completed. These and more elaborate ABA techniques can be used to shape a remarkable variety of behaviours to improve the independence and quality of life for people with autism.

Processes of Operant Conditioning

Listen to the Audio

In the previous section, you read about how the frequency of a behaviour can be increased (reinforcement) or decreased (punishment) by a number of different stimuli or responses. The obvious question, then, is why do some stimuli affect behaviour while others have no influence whatsoever? Is there a biological explanation for this difference?

Primary and Secondary Reinforcers

Listen to the Audio

Reinforcers can come in two main forms. **Primary reinforcers** *consist of reinforcing stimuli that satisfy basic motivational needs—needs that affect an individual's ability to survive (and, if possible, reproduce)*. Examples of these inherently reinforcing stimuli include food, water, shelter, and sexual contact. In contrast, **secondary reinforcers** *consist of stimuli that acquire their reinforcing effects only after we learn that they have value*. Money and Facebook "likes" are both examples of secondary reinforcers. They are more abstract and do not *directly* influence survival-related behaviours.

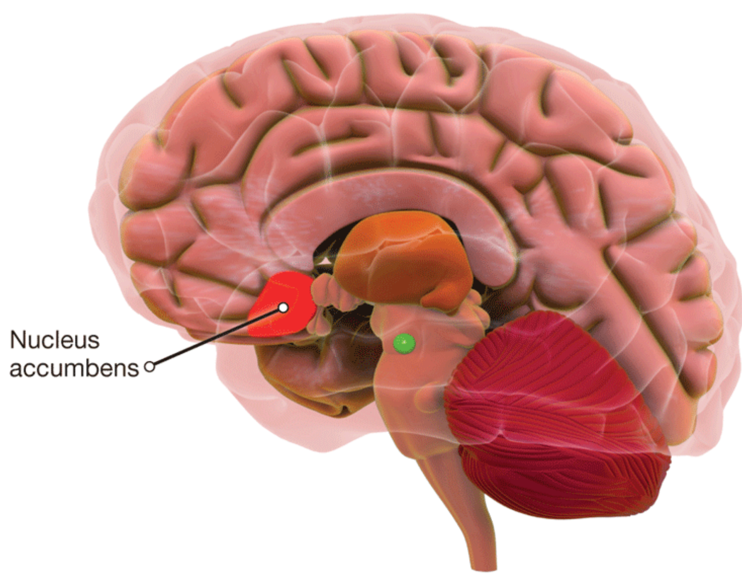
Animals pressing levers in operant chambers to receive rewards may seem artificial. However, if you look around you will see that our environment is full of devices that influence our operant responses.

Top: RisingStar/Alamy Stock Photo; bottom: Richard Goldberg/Shutterstock

Both primary and secondary reinforcers satisfy our drives, but what underlies the motivation to seek out these reinforcers? The answer is complex, but research points to a specific brain circuit, including a structure called the *nucleus accumbens* (see Figure 6.13). The nucleus accumbens becomes activated during the processing of all kinds of rewards, including primary ones such as eating and having sex, as well as "artificial" rewards such as using cocaine and smoking a cigarette.

Variations in this area might also account for why individuals differ so much in their drive for reinforcers. For example, scientists have discovered that people who are prone to risky behaviours such as gambling and alcohol abuse are more likely to have inherited particular copies of genes that code for dopamine and other reward-based chemicals in the brain (Comings & Blum, 2000; Volkow & Morales, 2015). Researchers have also found that individuals who are impulsive, and therefore vulnerable to gambling and drug abuse, release more dopamine in brain areas related to reward, and have trouble removing dopamine from the synapses in these areas (Buckholtz et al., 2010).

Figure 6.13 Reward Processing in the Brain



The nucleus accumbens is one of the brain's primary reward centres.

Secondary reinforcers also trigger the release of dopamine in reward areas of the brain. A number of neuroimaging experiments have shown that monetary rewards cause dopamine to be released in parts of the basal ganglia (Elliott et al., 2000) as well as in the medial regions of the frontal lobes (Knutson et al., 2003). Some of these areas directly overlap

with those involved with primary reinforcers (Valentin & O'Doherty, 2009).

How can dopamine be related to operant conditioning? When a behaviour is rewarded for the first time, dopamine is released (Schultz & Dickinson, 2000); this reinforces these new, reward-producing behaviours so that they will be performed again (Morris et al., 2006; Schultz, 1998). These dopamine-releasing neurons in the nucleus accumbens and surrounding areas help maintain a record of which behaviours are, and are not, associated with a reward. Interestingly, these neurons alter their rate of firing when you have to update your understanding of which actions lead to rewards; so, they are involved with *learning* new behaviour–reward associations as well as with reinforcement itself.

Discrimination and Generalization

Listen to the Audio

Once a response has been learned, the individual may soon learn that reinforcement or punishment will occur under only certain conditions and circumstances. A pigeon in an operant chamber may learn that pecking is reinforced only when the chamber light is switched on, so there is no need to continue pecking when the light is turned off. This illustrates the concept of a **discriminative stimulus**—*a cue or event that indicates that a response, if made, will be reinforced*. Our lives are filled with discriminative stimuli. Before we pour a cup of coffee, we might check whether the light on the coffee maker is on—a discriminative stimulus that tells us the beverage will be hot and, presumably, reinforcing. There are also numerous social examples of discriminative stimuli. For instance, you might only ask to borrow your parents' car when they show signs of being in a good mood. In this case, your parents' mood (smiling, laughing, etc.) will dictate whether you perform a behaviour (asking to borrow the car). Discriminative stimuli demonstrate that we (and animal subjects) can use cues from our environment to help us decide whether to perform a conditioned behaviour.

The idea of a discriminative stimulus should not be confused with the concept of *discrimination*. **Discrimination** *occurs when an organism learns to respond to one original discriminative stimulus but not to new stimuli that may be similar to the original stimulus*. For example, a pigeon may learn that it will receive a reward if it pecks at a key after a 1000-Hz tone, but not if it performs the same action following a 2000-Hz tone. As a result,

the pigeon won't peck at the key after a 2000-Hz tone. Or, to extend our earlier example, you may quickly learn that your father will lend you the car, whereas your mother will not. In this case, the process of discrimination would lead you to perform a behaviour (asking to borrow the car) when you are with your father but not when you are with your mother.

In contrast to discrimination, **generalization** *takes place when an operant response occurs in response to a new stimulus that is similar to the stimulus present during original learning*. In this case, a pigeon who learned to peck a key after hearing a 1000-Hz tone may attempt to peck the key whenever *any* tone is presented. If petting a neighbour's border collie (a type of dog) led to a child laughing and playing with the animal, then they might be more likely to pet other dogs or even other furry animals. In this instance, a specific reinforcement related to an action (petting a *specific* dog) led to a similar behaviour (petting) occurring in other instances (petting *other* dogs).

If you've noticed similarities between discrimination and generalization in operant conditioning and the same processes in classical conditioning (see Module 6.1), you are not mistaken. The same general logic underlies these concepts in both types of conditioning. However, while discrimination and generalization in classical conditioning were due to the strengthening of synapses as a result of simultaneous firing, in operant conditioning, the mechanism appears to be dopamine-secreting neurons.

Delayed Reinforcement and Extinction

Listen to the Audio

The focus of this module thus far has been on behavioural and biological responses to reinforcement and punishment. In most studies exploring these responses, the reward or punishment occurred immediately following the behaviour. This allows individuals to predict when a reward will occur (Schultz & Dickinson, 2000). But you know from your own life that rewards are not always immediate. What happens if the reward is delayed, or doesn't occur at all? As early as 1911, Thorndike (the cat imprisoner) noted that reinforcement was more effective if there was very little time between the action and the consequence. Indeed, in a study with pigeons, researchers found that the frequency of responses (pecking a button) decreased as the amount of time between the pecking and the reward (a food pellet) increased (Chung & Herrnstein, 1967). Interestingly, neuroscientists have found that neural activity decreases during this time as well. In fact, delays of as little as half a second decrease the amount of neural activity in dopamine-releasing neurons (Hollerman & Schultz, 1996).

This effect of *delayed reinforcement* influences a number of human behaviours as well. For instance, drugs that have their effect (i.e., produce their rewarding feeling) soon after they are taken are generally more addictive than drugs whose effects occur several minutes or hours after being taken. This difference is due, in part, to the ease with which one can mentally associate the action of taking the drug with reinforcement from the drug (the consequence).

Injecting drugs allows them to enter the bloodstream and therefore the brain more quickly than if they are taken orally. This is one reason why injected drugs are often more addictive than pills.

Victoria M/Fotolia

Sometimes, however, a reinforcer is not just delayed; it doesn't occur at all. A pigeon may find that pressing a key in its operant chamber no longer leads to a food reward. You may find that your parents no longer let you borrow the car no matter how nicely you ask. Although both you and the pigeon may persist in your behaviour for a while, eventually you'll stop. This change is known as **extinction**, *the weakening of an operant response when reinforcement is no longer available*. If you lose your internet connection, for example, you will probably stop trying to refresh your web browser because there is no reinforcement for doing so—the behaviour will no longer be performed. Extinction, like most of the observable behaviours you've read about in this module, is related to dopamine. If you expect a reward for your behaviour and none comes, the amount of dopamine being released decreases (Schultz, 1998).

Dopamine release will increase again when there is a new behaviour–reward relationship to learn.

Table 6.3 differentiates among the processes of extinction, generalization, and discrimination in classical and operant conditioning.

Table 6.3

Comparing Discrimination, Generalization, and Extinction in Classical and Operant Conditioning

Table 6.3

Comparing Discrimination, Generalization, and Extinction in Classical and Operant Conditioning

Process	Classical Conditioning	Operant Conditioning
Discrimination	A CR does not occur in response to a different CS that resembles the original CS.	There is no response to a stimulus that resembles the original discriminative stimulus used during learning.
Generalization	A different CS that resembles the original CS used during acquisition elicits a CR.	Responding occurs to a stimulus that resembles the original discriminative stimulus used during learning.
Extinction	A CS is presented without a US until the CR no longer occurs.	Responding gradually ceases if reinforcement is no longer available.

Reward Devaluation

Listen to the Audio

In all of these examples of operant conditioning, the value of the reinforcement remained the same. But if you think about your own life, it quickly becomes apparent that this is not always the case. Food is incredibly rewarding when you are hungry but becomes less so after you have eaten a large meal. Similarly, $100 may seem like a lot of money to a starving student, but would seem less important to a doctor with a high income. If a behaviour is more likely to occur because of reward, what happens when the reward becomes less rewarding?

Scientists have found that behaviours do change when the reinforcer loses some of its appeal (Colwill & Rescorla, 1985, 1990). In a typical experiment, rats are trained to press two different levers, each associated with a different reward (e.g., two different rewarding tastes). If the experimenters pre-feed the animal with one of these two tastes, they will crave it less than the other; in other words, its reward will be devalued compared to the other taste. Researchers consistently find a decrease in the response rate for the "devalued" reward, whereas the other reward remains largely unaffected.

Reward devaluation can also occur by making one of the rewards less appealing. In this version of reward devaluation, one of the reinforcing tastes is paired with a toxin that made the rats feel ill; this obviously reduces its value! (Ideally, this pairing would occur outside of the operant chamber so that the toxin didn't serve as a positive punishment.) The rats

would then have the choice of two levers to press, one associated with a rewarding taste and the other associated with the taste that is now less rewarding than before. When these rats were later given the opportunity to choose between the two operant learning tasks, they showed a strong preference for the task whose reward had not been devalued (Colwill & Rescorla, 1985, 1990). Neurons in the nucleus accumbens play an important role in altering behaviour and "expectations" about rewards that are devalued (West & Carelli, 2016). For example, neurons in some regions of the nucleus accumbens fire less when a reward that has been devalued is made available. Think of a favoured food item that temporarily loses its status as a strong incentive after you have just eaten.

Reinforcement Schedules and Operant Conditioning

Listen to the Audio

Think about the last time you did something nice for a friend. How did they respond? You may have received a hug. They may have said "Thanks!" and smiled. Regardless, you likely received some positive feedback that made you feel like your behaviour was worth repeating. Now think about the last time you played a sport or a video game. Not every shot would have hit the target, so your behaviour wasn't reinforced each time. But it was likely reinforced *some of the time*. These real-world examples show you that some behaviours are reinforced more consistently than others. The question that interested psychologists was "How do these different patterns of reinforcement affect learning?"

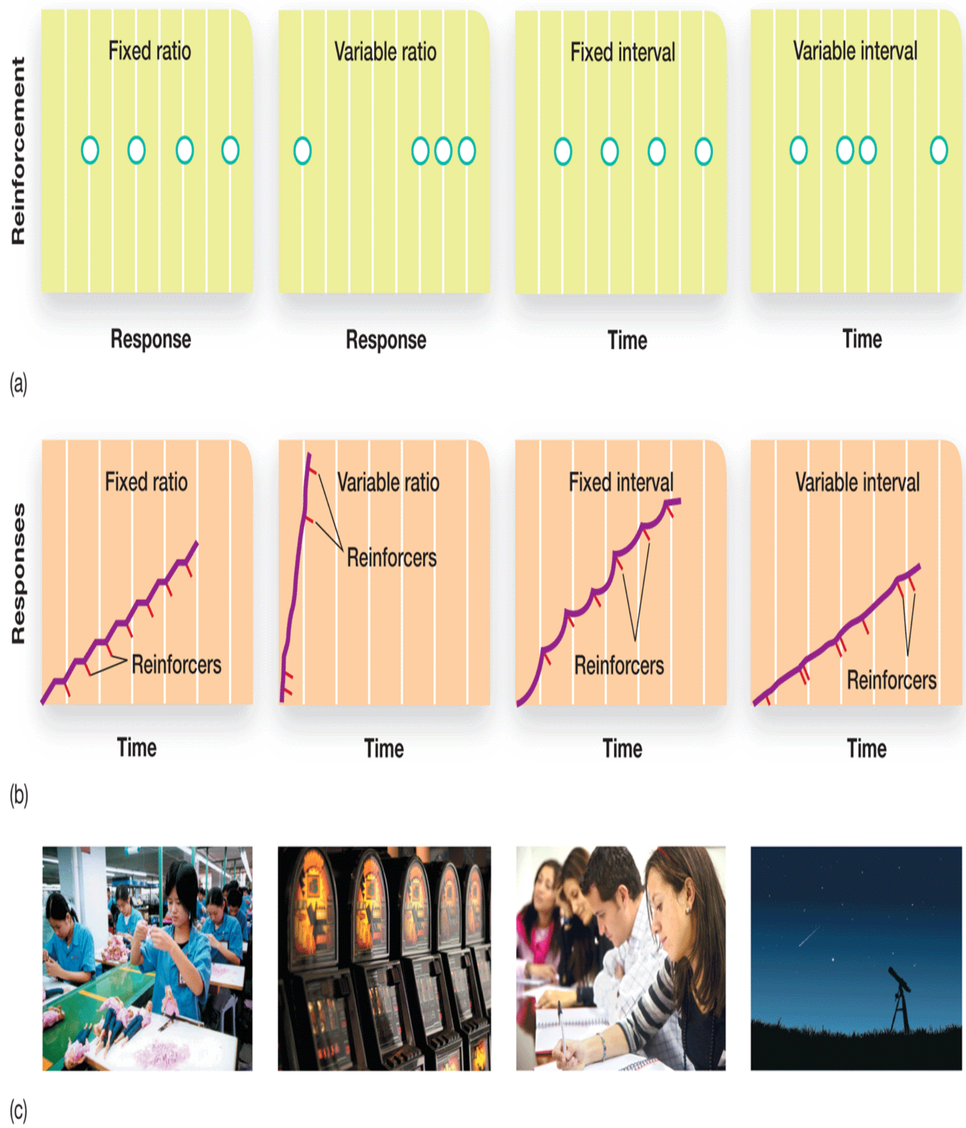
Schedules of Reinforcement

Listen to the Audio

Operant conditioning occurs, intentionally or unintentionally, in many different areas of our lives. However, the exact timing of the action and reinforcement (or punishment) differs across situations. Typically, a given behaviour is rewarded according to some kind of schedule. These **schedules of reinforcement**—*rules that determine when reinforcement is available*—can have a dramatic effect on the learning, relearning, or unlearning of responses (Ferster & Skinner, 1957). Reinforcement may be available at highly predictable or very irregular times. Also, reinforcement may be based on how often someone engages in a behaviour, or on the passage of time.

During **continuous reinforcement**, *every response made results in reinforcement*. As a result, learning initially occurs rapidly. For example, vending machines (should) deliver a snack every time the correct amount of money is deposited. In other situations, not every action will lead to reinforcement; we also encounter situations where reinforcement is available only some of the time. For example, phoning a friend may not always get you an actual person on the other end of the call. In this kind of **partial (intermittent) reinforcement**, *only a certain number of responses are rewarded, or a certain amount of time must pass before reinforcement is available*. Four types of partial reinforcement schedules are possible (see Figure 6.14). These schedules have different effects on rates of responding.

Figure 6.14 Schedules of Reinforcement



(a) Four types of reinforcement schedule are shown here: fixed ratio, variable ratio, fixed interval, and variable interval. Notice how each schedule differs based on when reinforcement is available (interval schedules) and on how many responses are required for reinforcement (ratio schedules). (b) These schedules of reinforcement affect responding in different ways. For example, notice the vigorous responding that is characteristic of the variable ratio schedule, as indicated by the steep upward trajectory of responding. (c) Real-world examples of the four types of reinforcement schedules.

Photos: bottom left: Li jianbin/Imaginechina/AP Images; bottom centre left: Lightreign/Alamy Stock Photo; bottom centre right: Andresr/Shutterstock; bottom right: Bill Fehr/Shutterstock

In the descriptions that follow, try to remember the following four terms as they are used in operant conditioning:

- Ratio schedule: This means that the reinforcements are based on the *amount of responding*.
- Interval schedule: This means that the reinforcements are based on the *amount of time between reinforcements, not* the number of responses an animal (or human) makes.
- Fixed schedule: This means that the schedule of reinforcement remains the same over time.
- Variable schedule: This means that the schedule of reinforcement, although linked to an average (e.g., 10 lever presses or 10 seconds), varies from reinforcement to reinforcement.

Keeping these distinctions in mind should help you make sense of the four reinforcement schedules discussed below.

In a **fixed-ratio schedule**, *reinforcement is delivered after a specific number of responses have been completed*. For example, a rat may be required to press a lever 10 times to receive food. Similarly, a worker in a factory may get paid based on how many items they worked on (e.g., receiving $1 for every five items produced). In both cases, a certain number of responses is required before a reward is given.

In a **variable-ratio schedule**, *the number of responses required to receive reinforcement varies according to an average*. A VR5 (variable ratio with an average of five trials between reinforcements) could include trials that require seven lever presses for a reward to occur, followed by four, then six, then three, and so on. But, the average number of responses required

to receive reinforcement would be five. Slot machines at casinos operate on variable-ratio reinforcement schedules. The odds are that the slot machine will not give anything back, but sometimes a player will win a small amount of money. Of course, hitting the jackpot is very infrequent. The variable nature of the reward structure for playing slot machines helps explain why responding on this schedule can be vigorous and persistent. Slot machines and other games of chance hold out the *possibility* that at some point players will be rewarded, but it is unclear how many responses will be required before the reward occurs. The fact that the reinforcement is due to the number of times a player responds promotes strong response levels (i.e., more button presses or lever pulls on a slot machine). In animal studies, variable-ratio schedules lead to the highest rate of responding of the four types of reinforcement schedules.

Psych@

Never Use Multiline Slot Machines

When casinos first became popular in the middle of the 20th century, people who used slot machines would pull a lever. Wheels with different images or numbers would spin around; if the correct combination of numbers appeared, the player would win a reward (often paired with loud noises and hundreds of coins being dispensed). In modern casinos, the slot machines are computerized. This technology has allowed game designers to add a sinister trick to slot machines: It is now possible for players to bet on several lines (rows) of numbers rather than on just one. These *multiline slot machines* therefore allow the player to make multiple bets on each “spin.” On the surface, this doesn’t seem alarming. But these machines are using operant conditioning against players. For

each line that a player bets on, they have to insert money into the machine. So, if a player is betting on nine lines, they would put $9 into the machine. Then the machine "spins" so that the numbers and symbols on each line change. On many of these spins, the player will win, a result that is paired with rewarding celebratory sound effects as well as money. However, the "win" will be for less money than the original total bet (e.g., winning $5 after putting $9 into the machine). In other words, it is a *loss* that is *disguised as a win* (Dixon et al., 2010). In an interview, one game designer wrote, "[W]e give them a sense of winning but also continue to accrue [their] credits" (Dow Schull, 2012, p. 121). Indeed, gambling researchers at the University of Waterloo have worked out the mathematics for these slot machines and found that players will double their bets only 20% of the time and will win 10 times their initial bet (viewed as a "big win" by gamblers) less than 1% of the time (Harrigan et al., 2014). And yet, due to the little rewards on each trial—the losses disguised as wins—gamblers continue to press the buttons. The house always wins in the long run.

Multiline video slot machines allow a player to bet on more than one line of numbers and symbols at a time. However, the small "wins" that players experience are often smaller than their overall losses.

Frans lemmens/Alamy Stock Photo

In contrast to ratio schedules, interval schedules are based on the passage of time, not the number of responses. A **fixed-interval schedule** *reinforces the first response occurring after a set amount of time passes*. If your psychology professor gives you an exam every four weeks, your reinforcement for studying is on a fixed-interval schedule. In Figure 6.14, notice how the fixed-interval schedule shows that responding drops off after each reinforcement is delivered (as indicated by the tick

marks). However, responding increases because reinforcement is soon available again. This schedule may reflect how you devote time to studying for your next exam—studying time tends to decrease after an exam, and then builds up again as another test looms.

The final reinforcement schedule is the **variable-interval schedule**, *in which the first response is reinforced following a variable amount of time*. The time interval varies around an average. For example, if you were watching the nighttime sky during a meteor shower, you would be rewarded for looking upward at irregular times. A meteor may fall on average every five minutes, but there will be times of inactivity for a minute, 10 minutes, eight minutes, and so on.

As you can see from Figure 6.14, ratio schedules tend to generate relatively high rates of responding. This outcome makes sense in light of the fact that in ratio schedules, reinforcement is based on how often you engage in the behaviour (something you have some control over) versus how much time has passed (something you do not control). For example, looking up with greater frequency does not *cause* more meteor activity because a variable-interval schedule is in effect. In contrast, a salesperson is on a variable-*ratio* schedule because approaching more customers increases the chances of making a sale.

One general characteristic of schedules of reinforcement is that partially reinforced responses tend to be very persistent. For example, although people are only intermittently reinforced for putting money into a slot machine, a high rate of responding is maintained and may not decrease until after a great many losses in a row (or the individual runs out of money). The effect of partial reinforcement on responding is especially evident during extinction. The **partial reinforcement effect** *refers to a phenomenon in which organisms that have been conditioned under partial reinforcement resist extinction longer than those conditioned under continuous*

reinforcement. This effect is likely due to the fact that the individual is accustomed to not receiving reinforcement for every response; therefore, a lack of reinforcement is not surprising and does not alter the motivation to produce the response, even if reinforcement is no longer available. We see this effect in many situations ranging from gambling, to cheesy pick-up lines in bars, to the numerous superstitions developed by professional and amateur athletes.

Working the Scientific Literacy Model

Reinforcement and Superstition

Listen to the Audio

It is clear that reinforcement can appear in multiple forms and follows various schedules. What all forms have in common is the notion that the behaviour that brought about the reinforcement will be strengthened. But what happens if the organism is mistaken about what caused the reinforcement to occur—will it experience reinforcement anyway? This raises the topic of superstition.

What do we know about superstition and reinforcement?

Reinforcement is often systematic and predictable. If it is not, then behaviour is eventually extinguished. In some cases, however, it is not perfectly clear what brings about the reinforcement. Imagine a baseball player who tries to be consistent in how they pitch. After a short losing streak, the pitcher suddenly wins a big game. If they are playing the same way, then what happened to change the outcome of the game? Did an alteration in their pre-game ritual lead to the victory? Humans the world over are prone to believing that some ritual or lucky charm will somehow improve their chances of success or survival. Psychologists believe these superstitions can be explained by operant conditioning.

How can science explain superstition?

Decades ago, B. F. Skinner (1948) attempted to create superstitious behaviour in pigeons. Food was delivered every 15 seconds, regardless of what the pigeons were doing. Over time, the birds started engaging in "superstitious" behaviours. The pigeons repeated the behaviour occurring just before reinforcement, even if the behaviour was scratching, head-bobbing, or standing on one foot. A pigeon that happened to be turning in a counterclockwise direction when reinforcement was delivered repeated this seemingly senseless behaviour.

Humans are similarly superstitious. For example, in one laboratory study, psychologists constructed a doll that could spit marbles (Wagner & Morris, 1987). Children were told that the doll would sometimes spit marbles at them and that these marbles could be collected and traded for toys. The marbles were ejected at random intervals, leading several of the children to develop superstitious behaviours such as sucking their thumbs or kissing the doll on the nose.

Research on superstition in humans suggests that we are prone to acquiring an "illusion of control," meaning that people mistakenly believe that their behaviour causes events to occur. Someone who performs an action that is followed by a desired outcome will repeat it, even if the outcome is not actually caused by the behaviour. This is especially likely if the probability of the outcome is already high. For example, back pain comes and goes, and so there is a high probability that if your back hurts, that pain will lessen at some point. If you tried some new, untested treatment and your pain goes away, you are likely to return to that remedy the next time, even if science eventually finds that it is no different than a placebo. Superstitious beliefs can also occur for negative events, such as walking beneath ladders or wearing

something with the number 13 printed on it. In these cases people believe that their behaviour can reduce the probability of an outcome that is actually independent of their behaviour (e.g., "I had good luck because I switched my number to 14"). These types of beliefs can be highly persistent, and people are adept at devising reasons to continue believing that their behaviour reduced an undesired, though uncontrolled, event (Matute & Blanco, 2014).

Can we critically evaluate these findings?

Superstitious beliefs, though irrational on the surface, may enhance individuals' belief that they can perform successfully at a task. Sometimes these beliefs can even enhance performance. These findings, however, are best applied to situations where the participant has some control over an outcome, such as taking an exam or playing a sport. People who spend a lot of time and money gambling are known to be quite superstitious, but it is important to distinguish between games of chance versus skill in this setting. "Success" at most gambling games is due entirely, or predominantly, to chance. Thus, the outcomes are immune to the superstitious beliefs of the players.

Superstitions are also prone to the confirmation bias—the tendency to seek out evidence in favour of your existing views and ignore inconsistent information—and the partial reinforcement effect discussed above. If an athlete believes that a superstitious behaviour leads to success, then they will notice when the behaviour *does* lead to success. However, given that losing is generally part of being an athlete, there will be times when the behaviour is not reinforced. Given what you've read about the partial reinforcement effect, it is easy to see how a superstitious behaviour could be difficult to change. For instance, former NHL goaltender Patrick Roy was as famous for his many

superstitions as he was for his playoff heroics. During every game he would (1) skate backwards toward his net before spinning around at the last minute (which made it appear smaller), (2) talk to his goalposts, (3) thank his goalposts when the puck hit one of them, and (4) avoid touching the blue line and red line when skating off the ice. Roy has the second-highest total of wins for NHL goalies and the most playoff wins in history (151). He won the Stanley Cup four times and was the playoffs' Most Valuable Player three times (an NHL record). But, in addition to his 702 reinforcers, he also lost over 400 games in his impressive career.

Why is this relevant?

Between Skinner's original work with pigeons and more contemporary experiments with people, it appears that operant conditioning plays a role in the development of some superstitions. Perhaps you have a good luck charm or a ritual you must complete before a game or even before taking a test. Think about what brings you luck, and then try to identify why you believe in this relationship. Can you identify a specific instance when you were first reinforced for this behaviour? Then remember that the superstition is a form of reinforcement, a linking of a behaviour and a response that is formed *in your mind*. Whether a superstition affects your performance is based on whether or not you allow it to.

Applying Punishment

Listen to the Audio

People tend to be more sensitive to the unpleasantness of punishment than they are to the pleasures of reward. Psychologists have demonstrated this asymmetry in laboratory studies with university students who played a computerized game in which they could choose a response that could bring either a monetary reward or a monetary loss. It turns out that the participants found losing money to be about three times as punishing as being rewarded with money was pleasurable. In other words, losing $100 is three times more punishing than gaining $100 is reinforcing (Rasmussen & Newland, 2008).

The use of punishment raises some ethical concerns—especially when it comes to physical means. A major issue that is debated all over the world is whether corporal punishment (e.g., spanking) is acceptable to use with children. In fact, more than 20 countries, including Sweden, Austria, Finland, Denmark, and Israel, have banned the practice. It is technically legal to spank a child aged 2 to 12 in Canada; in a contentious decision, the Supreme Court of Canada (in a 6–3 vote) upheld Section 43 of the *Criminal Code* allowing spanking (Supreme Court of Canada, 2004). Some parents use this tactic because it works: Spanking is generally a very effective punisher when it is used for immediately stopping a behaviour (Gershoff, 2002). However, one reason so few psychologists advocate spanking is because it is associated with some major side effects (Gershoff, 2002; Gershoff & Bitensky, 2007). In a review of this research published in the *Canadian Medical Association Journal*, investigators at the

University of Manitoba noted that spanking has been *associated* with poorer parent–child relationships, poorer mental health for both adults and children, delinquency in children, and increased chances of children becoming victims or perpetrators of physical abuse in adulthood (Durrant & Ensom, 2012).

Watch Thinking Like a Psychologist: Physical Punishment

It is also important to note that, while punishment may suppress an unwanted behaviour temporarily, by itself it does not teach which behaviours are appropriate. As a general rule, punishment of any kind is most effective when combined with reinforcement of an alternative, suitable response. Table 6.4 offers some general guidelines for maximizing the effects of punishment and minimizing negative side effects.

Table 6.4 Punishment Tends to Be Most Effective When Certain Principles Are Followed

Table 6.4 Punishment Tends to Be Most Effective When Certain Principles Are Followed

Principle	Description and Explanation
Severity	Should be proportional to offence. A small fine is suitable for parking illegally or littering, but inappropriate for someone who commits assault.
Initial punishment level	The initial level of punishment needs to be sufficiently strong to reduce the likelihood of the offence occurring again.
Contiguity	Punishment is most effective when it occurs immediately after the behaviour. Many convicted criminals are not sentenced until many months after they have committed an offence. Children are given detentions that may not begin until hours later. Long delays in punishment are known to reduce its effectiveness.
Consistency	Punishment should be administered consistently. A parent who only occasionally punishes a teenager for breaking curfew will probably have less success in curbing the behaviour than a parent who uses punishment consistently.
Show alternatives	Punishment is more successful, and side effects are reduced, if the individual is clear on how reinforcement can be obtained by engaging in appropriate behaviours.

Are Classical and Operant Learning Distinct Events?

Listen to the Audio

It is tempting to think of behaviour as being due to *either* classical conditioning *or* operant conditioning. However, it is possible, even likely, that a complex behaviour is influenced by both types of learning, each influencing behaviour in slightly different ways. Consider gambling with video lottery terminals, the topic of the opening story in this module. As discussed, slot machines and VLTs use a variable-ratio schedule of reinforcement, a type of operant conditioning that leads to a high response rate. But, the flashy lights, the dinging sounds coming from the machine, and even the chair all serve as conditioned stimuli for the unconditioned response of excitement associated with gambling (Dixon et al., 2014). So, classical conditioning produces an emotional response and operant conditioning maintains the behaviour. Given these forces, should we really be surprised that VLTs are so alluring to people, in particular those prone to problem gambling (Clarke et al., 2012; Nicki et al., 2007)?

Module 6.2 Summary

Listen to the Audio

6.2a Know . . . the key terminology associated with operant conditioning.

Review Module 6.2

Start Over Swap

0/29 REVIEWED · 0 MASTERED

variable-ratio schedule

Previous Next Got It!

6.2b Understand . . . the role that consequences play in increasing or decreasing behaviour.

Positive and negative reinforcement increase the likelihood of a behaviour, whereas positive and negative punishment decrease the

likelihood of a behaviour. Positive reinforcement and positive punishment involve adding a stimulus to the situation, whereas negative reinforcement and negative punishment involve removal of a stimulus.

6.2c Understand . . . how schedules of reinforcement affect behaviour.

Schedules of reinforcement can be fixed or variable, and can be based on intervals (time) or ratios (the number of responses). As can be seen in Figure 6.14, variable-ratio schedules produce the most robust learning; reinforcement is linked to the animal's (or human's) response rather than to an amount of time, but the animal never knows how many responses will be necessary for a reward to occur. Variable-interval schedules lead to the slowest rate of learning.

6.2d Apply . . . your knowledge of operant conditioning to examples.

The concepts of positive and negative reinforcement and punishment are often the most challenging when it comes to this material.

Apply Activity Applying Reinforcement and Punishment

Read the following scenarios and determine whether positive reinforcement, negative reinforcement, positive punishment, or negative punishment explains the change in behaviour. Complete the table by selecting the appropriate answer.

Process	Scenario
	Bill is caught cheating on multiple examinations. As a consequence, the school principal suspends him for a three-day period. Bill likes being at school and, when he returns from his suspension, he no longer cheats on exams. Which process explains the change in Bill's behaviour?
	Ericka earns A's in all of her math classes. Throughout her schooling, she finds that the personal and social rewards for excelling at math continue to motivate her. She eventually completes a graduate degree and teaches math. Which process explains her passion for math?
	Automobile makers install sound equipment that produces annoying sounds when a door is not properly shut, lights are left on, or a seat belt is not fastened. The purpose is to increase proper door shutting, turning off of lights, and seat belt fastening behaviour. Which process explains the behavioural change these sounds are attempting to make?
	Hernan bites his fingernails and cuticles to the point of bleeding and discomfort. To reduce this behaviour, he applies a terrible-tasting topical lotion to his fingertips and the behaviour stops. Which process explains Hernan's behavioural change?

Start Over

6.2e Analyze . . . the effectiveness of punishment on changing behaviour.

Many psychologists recommend that people rely on reinforcement to teach new or appropriate behaviours. The issue here is not that punishment does not work, but rather that there are some notable drawbacks to using punishment as a means to change behaviour. For example, punishment may teach individuals to engage in avoidance or aggression, rather than developing an appropriate alternative behaviour that can be reinforced.

Module 6.3 Cognitive and Observational Learning

Listen to the Audio

Dr. Edwin van Leeuwen

Learning Objectives

6.3a Know . . . the key terminology associated with cognitive and observational learning.

6.3b Understand . . . the concept of latent learning and its relevance to cognitive aspects of learning.

6.3c Apply . . . principles of observational learning outside of the laboratory.

6.3d Analyze . . . the claim that viewing violent media increases violent behaviour.

Celebrity fashion statements often soon become the norm. People pay for jeans that are neatly torn or shredded. Trends to wear skinny jeans, baggy jeans, and even the option of wearing them backward spread from person to person. Our capacity to adopt customs, pointless as they may be, is evident across human societies. It appears this capacity is not uniquely human. Take Julie, for example, a chimpanzee that developed a habit of placing a long piece of grass in her ear, and keeping it there for prolonged periods of time (Van Leeuwen et al., 2014). Julie did this frequently over a three-year period. She did not appear to be using the grass to scratch an itchy ear or to extract a small critter that made its way inside. The behaviour seemed to have no adaptive function. Granted, we may not regard Julie's behaviour as a fashion statement worth copying, but other chimpanzees in her social group did. Following Julie's innovation, several chimpanzees in her social group began putting grass in their ears. Although humans take imitation to a very high level, as we will see in this module, the capacity to do so is not unique to us.

The first two modules of this chapter focused on relatively basic ways of learning. Classical conditioning occurs through the formation of associations (Module 6.1), and operant conditioning involves changes in behaviour due to rewarding or punishing consequences (Module 6.2). Both types of learning emphasize relationships between stimuli and responses and avoid making reference to the *thinking* part of the

learning process. However, psychologists also recognize that cognitive processes such as thinking and remembering are useful to theories and explanations of how we learn.

Cognitive Perspectives on Learning

Listen to the Audio

Cognitive psychologists have contributed a great deal to psychology's understanding of learning. In some cases, they have presented a very different view from behaviourism by addressing unobservable mental phenomena. In other cases, their work has simply complemented behaviourism by integrating cognitive accounts into even the seemingly simplest of learned behaviours, such as classical and operant conditioning.

Latent Learning

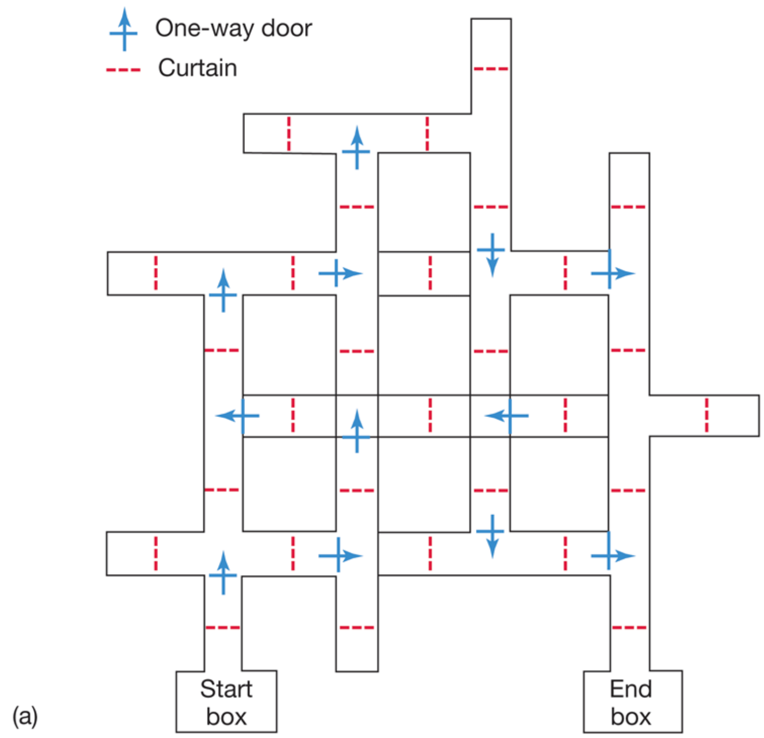
Listen to the Audio

Much of human learning involves absorbing information and then demonstrating what we have learned by performing a task, such as taking a quiz or exam. Learning, and reinforcement for learning, may not be expressed until there is an opportunity to do so. In other words, learning may be occurring even if there is no behavioural evidence of it taking place.

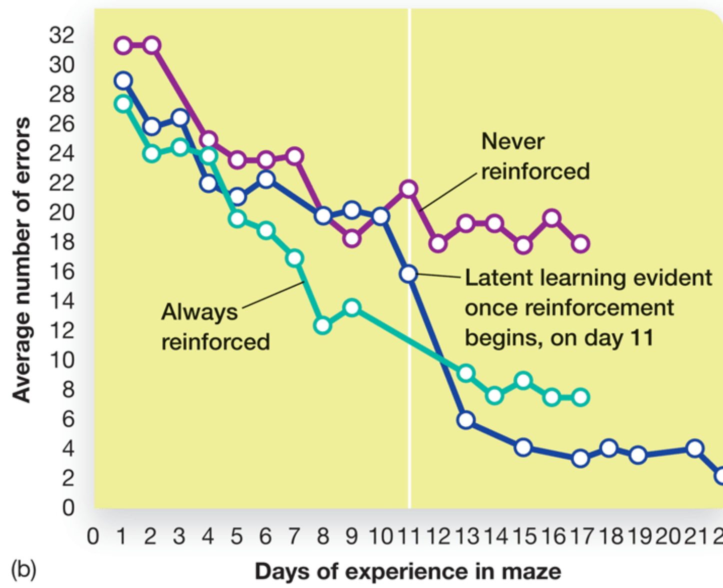
Psychologist Edward Tolman proposed that humans, and even rats, express **latent learning**—*learning that is not immediately expressed by a response until the organism is reinforced for doing so*. Tolman and Honzik (1930) demonstrated latent learning in rats running a maze (see Figure 6.15). The first group of rats could obtain food if they navigated the correct route through the maze. They were given 10 trials to figure out an efficient route to the end of the maze, where food was always waiting. A second group was allowed to explore the maze, but did not have food available at the other end until the 11th trial. A third group (a control) never received food while in the maze. It might seem that only the first group—the one that was reinforced on all trials—would learn how to best shuttle from the start of the maze to the end. After all, it was the only group that was consistently reinforced. This is, in fact, what happened—at least for the first 10 trials. Tolman and Honzik discovered that rats that were finally rewarded on the 11th trial quickly performed as well as the rats that were rewarded on every trial (see Figure 6.15). It appears that this second group of rats was learning after all, but only demonstrated

their knowledge when they received reinforcement worthy of quickly running through the maze.

Figure 6.15 Learning without Reinforcement



Source: Ciccarelli, S. K., & Noland White, J. (2010). *Psychology: An Exploration*, 1st ed., © 2010, pp. 79, 81, 141. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.



Source: Adapted from Tolman, E. C., & Honzik, C. H. (1930), Degrees of hunger, reward and non-reward and maze learning in rats. *University of California Publications in Psychology*, 4241–4256.

Tolman and Honzik (1930) placed rats in the start box and measured the number of errors they made in getting to the end box. Rats that were reinforced during the first 10 days of the experiment made fewer errors. Rats that were reinforced on day 11 immediately made far fewer errors, which indicated that they had learned some spatial details of the maze even though food reinforcement was not available during the first 10 trials for this group.

If you put yourself in the rat's shoes—or perhaps paws would be more appropriate—you will realize that humans experience latent learning as well. Consider the layout of a university campus. In the first months of school, new students might wander around the campus to find different classrooms and perhaps the cafeteria, but they would probably leave entire buildings unexplored. Yet, if they were suddenly asked to meet someone in a specific building, they would likely be able to find that location without much problem (i.e., they would not wander aimlessly from building to building in a trial-and-error fashion as though investigating a new environment for the first time). The reason is that

they would have formed an understanding of the general area, even though that knowledge wasn't rewarded at the time. Tolman and Honzik assumed that this process held true for their rats, and they further hypothesized that rats possess a *cognitive map* of their environment, much like our own cognitive map of our surroundings. Their classic study is important because it illustrates that humans (and rats) acquire information in the absence of immediate reinforcement and that we can use that information when circumstances allow.

S-O-R Theory of Learning

Listen to the Audio

Latent learning suggests that individuals engage in more "thinking" than is shown by operant conditioning studies. Instead, cognitive theories of learning suggest that an individual actively processes and analyzes information; this activity influences observable behaviours as well as our internal mental lives. Because of the essential role played by the individual, this early view of cognitive learning was referred to as the *S-O-R theory* (*stimulus- organism-response theory*; Woodworth, 1929).

Stimulus–response (S–R) and S–O–R theorists both agreed that thinking took place; however, they disagreed about the content and causes of the thoughts. S–R psychologists (such as Thorndike) assumed that thoughts were based on the S–R contingencies that an organism had learned throughout its life; in other words, thinking was a form of behaviour. Individual differences in responding would therefore be explained by the different learning histories of the individuals. S–O–R psychologists, on the other hand, assumed that individual differences were based on people's (or animals') cognitive *interpretation* of that situation—in other words, what that stimulus meant to them. In this view, the same stimulus in the same situation could theoretically produce different responses based on a variety of factors, including an individual's mood, fatigue, the presence of other organisms, and so on. For example, the same comment to two coworkers might lead to an angry response from one person and laughter from another. The explanation for these differences is the *O* in

the S–O–R theory; each person or organism will think about or interpret a situation in a slightly different way.

Observational Learning

Listen to the Audio

The first two modules in this chapter focused on aspects of learning that require direct experience. Pavlov's dogs experienced the clicking sound of the metronome and the food, one right after the other, and learning occurred. Rats in an operant chamber experienced the reinforcing consequences of pressing a lever, and learning occurred. However, not all learning requires direct experience, and this is a good thing. Can you imagine if surgeons had to learn by trial and error? Who on earth would volunteer to be the first patient?

Luckily, many species, including humans, are able to learn new skills and new associations without directly experiencing them. **Observational learning** *involves changes in behaviour and knowledge that result from watching others*. Humans have elaborate cultural customs and rituals that spread through observation. The cultural differences we find in dietary preferences, clothing styles, athletic events, holiday rituals, music tastes, and so many other customs exist because of observational learning. Indeed, it is the primary way that adaptive behaviour spreads so rapidly within a population, even in nonhuman species (Heyes & Galef, 1996). For example, cats that observe others being trained to leap over a hurdle to avoid a foot shock learn the same trick faster than cats who did not observe this training (John et al., 1968). A less shocking example involves rats' foraging behaviour. Before setting off in search of food, rats smell the breath of other rats. They will then search preferentially for food that matches the odour of their fellow rats' breath. To humans, this practice

may not seem very appealing—but for rats, using breath as a source of information about food may help them survive. By definition, a breathing rat is a living rat, so clearly the food the animal ate did not kill it. Living rats are worth copying. Human children are also very sensitive to social cues about what they should avoid. Curious as they may be, even young children will avoid food if they witness their parents reacting with disgust toward it (Stevenson et al., 2010). However, for observational learning to occur, some key processes need to be in place if the behaviour is to be successfully transmitted from one person to the next.

Even rats have a special way of socially transmitting information. Without directly observing what other rats have eaten, rats will smell the food on the breath of other rats and then preferentially search for this food.

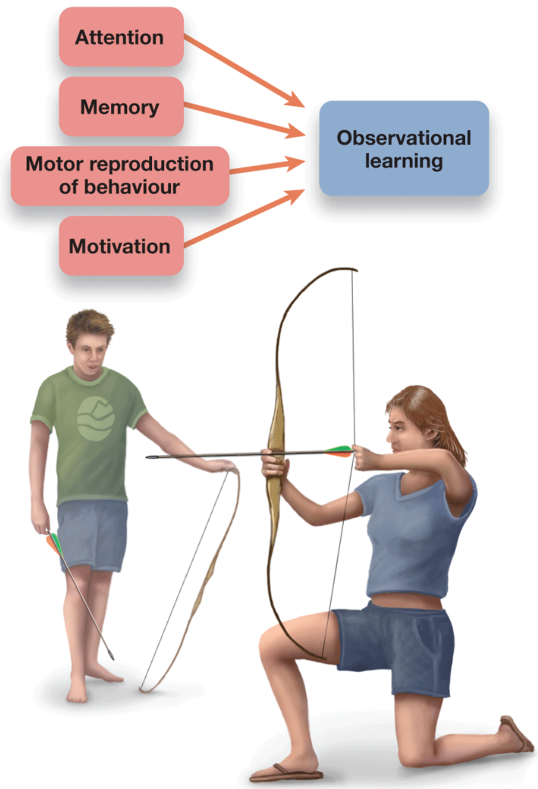
Cathy Keifer/Shutterstock

Processes Supporting Observational Learning

Listen to the Audio

Albert Bandura (Bandura, 1973; Bandura & Walters, 1963) identified four processes involved in observational learning: *attention* to the act or behaviour, *memory* for it, the *ability to reproduce it*, and the *motivation* to do so (see Figure 6.16). Without any one of these processes, observational learning would be unlikely—or at least would result in a poor rendition of the behaviour.

Figure 6.16 Processes Involved in Observational Learning



For observational learning to occur, several processes are required: attention, memory, the ability to reproduce the behaviour, and the motivation to do so.

First, consider the importance of attention. Seeing someone react with a classically conditioned fear to snakes or spiders can result in acquiring a similar fear—even in the absence of any direct experience with snakes or spiders (LoBue et al., 2010). As an example, are you afraid of sharks? It is likely that many of you have this fear, even if you live thousands of kilometres away from shark-infested waters. The fear you see on the faces of people in horror movies and in *Shark Week* documentaries is enough for you to learn this experience. Observational learning can extend to operant conditioning as well. Observing someone being rewarded for certain behaviours facilitates imitation of the same behaviours that bring about rewards.

Second, memory is an important facet of observational learning. When we learn a new behaviour, there is often a delay before the opportunity to perform it arises. If you tuned in to a cooking show, for example, you would need to recreate the steps and processes required to prepare the dish at a later time. Interestingly, memory for how to reproduce a behaviour or skill can be found at a very early age (Huang, 2012). Infants just nine months of age can reproduce a new behaviour (admittedly, a much simpler one than cooking), even if there is up to a one-week delay between observing the act and having the opportunity to reproduce it (Meltzoff, 1988).

Third, observational learning requires that the observer can actually reproduce the behaviour. This can be very challenging, depending on the task. Unless an individual has a physical impairment, learning an everyday task—such as operating a can opener—is not difficult. By comparison, hitting a baseball thrown by a Toronto Blue Jays pitcher requires a very specialized skill set. Research indicates that observational learning is most effective when we first observe, practise immediately, and continue practising and observing soon after acquiring the response. For example, one study found that the optimal way to develop and maintain motor (movement) skills is by repeated observation before and during the initial stages of practising (Weeks & Anderson, 2000). It appears that watching someone else helps us practise effectively, and allows us to see how errors are made. When we see a model making a mistake, we know to examine our own behaviour for similar mistakes (Blandin & Proteau, 2000; Hodges et al., 2007).

Myths in Mind

Is Teaching Uniquely Human?

Teaching is a significant component of human culture and a primary means by which information is learned in classrooms, at home, and in many other settings. But are humans the only species with the ability to teach others? Some intriguing examples of teaching-like behaviour have been observed in nonhuman species (Thornton & Raihani, 2010). Prepare to be humbled.

Teaching behaviour has been discovered in ants (Franks & Richardson, 2006)—probably the last species we might suspect would demonstrate this complex ability. For example, a “teacher” ant gives a “pupil” ant feedback on how to locate a source of food.

Field researchers studying primates discovered the rapid spread of potato-washing behaviour in Japanese macaque monkeys (Kawai, 1965). Imo—perhaps one of the more ingenious monkeys of the troop—discovered that potatoes could be washed in salt water, which also may have given them a more appealing taste. Potato-washing behaviour subsequently spread through the population, especially among the monkeys that observed the behaviour in Imo and her followers.

Transmission of new and unique behaviours typically occurs between mothers and their young (Huffman, 1996). Chimpanzee mothers, for example, actively demonstrate to their young the special skills required to crack nuts open (Boesch, 1991). Also, mother killer whales appear to show their offspring how to beach themselves (Rendell & Whitehead, 2001), a behaviour that is needed by the type of killer whale that feeds on seals that congregate along the shoreline.

In each of these examples, it is possible that the observer animals are imitating the individual who is demonstrating a behaviour. These observations raise the possibility that teaching may not be a uniquely human endeavour.

Primate researchers have documented the spread of potato washing in Japanese macaque monkeys across multiple generations. Monkeys appear to learn how to do this by observing experienced monkeys from their troop.

Miles Barton/Nature Picture Library

Is this killer whale teaching her offspring to hunt for seals? Researchers have found evidence of teaching in killer whales and a variety of other nonhuman species.

Danita Delimont Creative/Alamy Stock Photo

Finally, motivation is clearly an important component of observational learning. On the one hand, being hungry or thirsty will motivate an individual to find out where others are going to find food and drink. On the other hand, children who have no aspirations to ever play the piano will be less motivated to observe their teacher during lessons. They will also be less likely to practise the observed behaviour that they are trying to learn.

Observational punishment is also possible, but appears to be less effective at changing behaviour than reinforcement. Witnessing others experience negative consequences may decrease your chances of copying someone else's behaviour. Even so, we are sometimes surprisingly bad at

learning from observational punishment. Seeing the consequences of smoking, drug abuse, and other risky behaviours does not seem to prevent many people from engaging in the same activities.

Imitation and Mirror Neurons

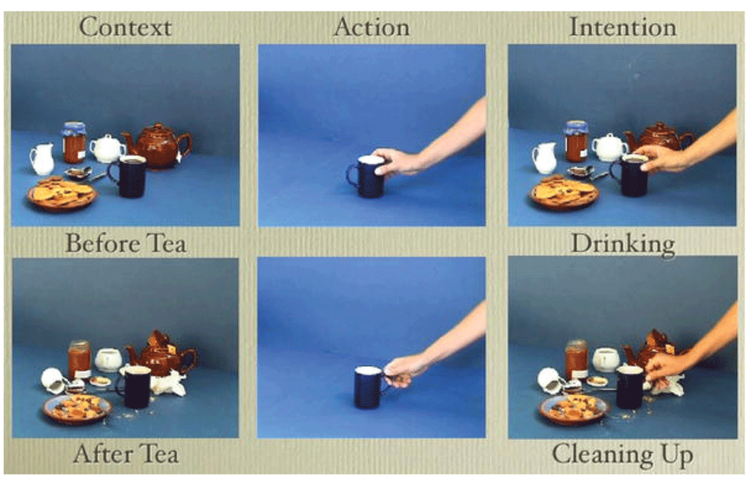
Listen to the Audio

One of the primary mechanisms that allows observational learning to take place is **imitation**—*recreating someone else's motor behaviour or expression, often to accomplish a specific goal*. Observe an 18-month old toddler in a social group and you will see imitation in action. Later, with greater physical and cognitive maturation, children readily imitate highly complex motor acts produced by a model, such as a parent, teacher, or friend. This ability seems to be something very common among humans. However, it is currently unclear what imitation actually is, although a number of theories exist. Some researchers suggest that children receive positive reinforcement when they properly imitate the behaviour of an adult and that imitation is a form of operant learning (Horne & Erjavec, 2007). Others suggest that imitation allows children to gain a better understanding of their own body parts versus the "observed" body parts of others (Mitchell, 1987). Finally, imitation might involve a more cognitive representation of one's own actions as well as the observed actions of someone else (Whiten, 2000). It is likely that all three processes are involved with imitation at different points in human (and some animal) development (Zentall, 2012).

Neuroscientists have provided additional insight into the functions of imitation. In the 1990s, Italian researchers discovered that groups of neurons in parts of the frontal lobes associated with planning movements became active both when a monkey performed an action *and* when it observed another monkey performing an action (di Pellegrino et al.,

1992). These cells, now known as *mirror neurons*, are also found in several areas in the human brain and have been linked to many functions ranging from understanding other people's emotional states to observational learning (Rizzolatti et al., 1996; Rizzolatti & Craighero, 2004). Additionally, groups of neurons appear to be sensitive to the context of an action. In one study, participants viewed a scene of a table covered in a plate of cookies, a teapot, and a cup (see Figure 6.17). In one photo of these items, the setting is untouched. In this case, reaching for the cup of tea would indicate that the person intended to have a sip. In another photo, many of the cookies are gone and the milk container has been knocked over. In this case, reaching for the cup of tea—the identical action as in the previous photo—would indicate that the person was cleaning up the mess. Incredibly, different groups of mirror neurons fired in response to the two images, despite the fact that the identical movement was being viewed (Iacoboni et al., 2005). These results suggest that the mirror neuron system—a key part of our ability to imitate—is sensitive to the purpose or goal of the imitated action.

Figure 6.17 Grasping Intentions of Mirror Neurons



Watching the same physical action—grabbing the teacup—in these two scenarios will lead to activity in different groups of neurons in the mirror neuron system. This suggests that the mirror neuron system is influenced by the goals of the actions, not just the physical action itself.

Source: From Iacoboni, M., Molnar-Szakacs, I., Gallese, V., Buccino, G., Mazziotta, J. C., and Rizzolatti, G. *PLoS Biol, 2005*, 3, e79. http://dx.doi.org/10.1371/journal.pbio.0030079.g001. Reprinted under open access license.

Television, movies, and music are generally experienced in a passive fashion. All that is required is that we watch and listen. Violent media can also be experienced in a more interactive fashion through video game play.

#Psych

Violence and Video Games

Can pixilated, fictional characters controlled by your hands make you more aggressive or even violent? Much has been said about the potential negative effects of consuming violent media (including games, movies, television shows, and music lyrics) on behaviour. Recently, due to a drastic upsurge in their popularity and sophistication, video games have also been labelled with parental advisory stickers. Some violent games, such as *Call of Duty* (over 200 million copies sold worldwide), involve shooting and blowing up the enemy. Other games, such as *Grand Theft Auto*, allow the player to commit illegal and violent acts. An obvious question is: Are video games related to aggressive behaviour (i.e., observational learning) in the same way that movies are?

Of course, the most important question is whether a regular pattern of playing violent video games *causes* violent behaviour. As you have learned the same issue applies to violent television, movies, and music lyrics. In 2015, the American Psychological Association issued a report claiming that there is a consistent link between violent video games and

violent behaviour. However, a number of academics disagreed with the methods used to come to these conclusions. For one, a "consistent link" shows that a relationship may exist between game play and aggression, but says nothing about whether there is a cause-and-effect relationship between them (Ferguson, 2015). Critics also pointed out that violent crime is decreasing in most countries despite the prevalence of video games. It is therefore unclear whether we should be worried about the effects that these games have on behaviour. A potentially greater concern may be the physically inactive lifestyle associated with frequent video game playing.

There are some experimental studies that have captured a lot of attention from psychologists. For example, Bushman and Anderson (2009) report that people who play violent games, instead of nonviolent ones, are less likely to help someone with an apparent injury. This and other work suggests that playing violent video games desensitizes gamers to violence (Anderson et al., 2007; but Gao et al., 2017 report no effect). These data don't mean that you should *never* play violent video games. And, you don't need replace playing *Resident Evil* with a steady diet of *Mario Kart*. Rather, these data show you that the media *can* influence your behaviour. It's up to you to become aware of how media violence can lead to (unintentional) observational learning. Doing so will help ensure that your actions are, in fact, your own.

Working the Scientific Literacy Model

Linking Media Exposure to Behaviour

Listen to the Audio

Imitating behaviours such as facial expressions or picking up teacups is fairly harmless. However, not all of the behaviours children see are this innocent. Children (and adults) are exposed to dozens of violent actions in the media, on the internet, and in computer games every day. If kids are imitating the behaviours they see in other contexts, does this mean that the media are "creating" potentially violent people?

What do we know about media effects on behaviour?

In some cases, learning from the media involves direct imitation; in other cases, what we observe shapes what we view as normal or acceptable behaviour. Either way, the actions people observe in the media can raise concerns, especially when children are watching. Given that North American children now spend an average of five hours per day interacting with electronic media, it is no wonder that one of the most discussed and researched topics in observational learning is the role of media violence in developing aggressive behaviours and desensitizing individuals to the effects of violence (Anderson et al., 2003; Huesmann, 2007). So how have researchers tackled the issue?

How can science explain the effect of media exposure on children’s behaviour?

One of the first experimental attempts to test whether exposure to violence begets violent behaviour in children was made by Albert Bandura and colleagues (1961, 1963). In a series of studies, groups of children watched an adult or cartoon character attack a “Bobo” doll, while another group of children watched adults who did not attack the doll. Children who watched adults attack the doll did likewise when given the opportunity, in some cases even imitating the specific attack methods used by the adults. The other children did not attack the doll. This classic study indicated that viewing aggression makes children at least temporarily more prone to committing aggressive acts toward an inanimate object.

In Albert Bandura's experiment, children who watched adults behave violently toward the Bobo doll were aggressive toward the same doll when given the chance—often imitating specific acts that they viewed.

Albert Bandura

Some scholars argue that viewing aggression is associated with increased aggression and desensitization to violence (Bushman & Anderson, 2007). In one Canadian study, Wendy Josephson (1987) had children aged seven to nine view a violent or nonviolent film before playing a game of floor hockey. Children

who viewed the violent film were more likely to act aggressively (i.e., to commit an act that would be penalized in a real hockey game). As an added twist, in some of the floor hockey games, a referee carried a walkie-talkie that had appeared in the violent film and thus served as a reminder of the violence. This movie-associated cue stimulated more violence, particularly in children who the teachers had indicated were prone to aggression.

Visual images are not the only source of media violence, however. Music, particularly hip hop and rap music (Herd, 2009), has become increasingly graphic in its depictions of violence over the past few decades. Some psychologists believe that songs with violent lyrics can lead to an increase in aggressive and hostile thoughts in a manner similar to violent movies (Anderson et al., 2003). In one study, German researchers asked male and female participants to listen to songs with sexually aggressive lyrics that were degrading to women. After listening to this music, the participants were asked to help out with a (staged) taste-preference study by pouring hot chili sauce into a plastic cup for another participant (who was actually a confederate of the experimenters). The researchers found that after listening to aggressive music that degraded women, males poured more hot sauce for a female than for a male confederate; this difference did not occur after listening to neutral music. Female participants did not show this effect. Male participants also recalled more negative and aggressive thoughts. Interestingly, when women listened to lyrics that were demeaning to men, they too recalled more negative and hostile information (Fischer & Greitmeyer, 2006). Thus, the effects of media violence are not limited to the visual domain and can affect both males and females.

Can we critically evaluate this research?

Exposure to violent media and aggressive behaviour and thinking are certainly related to each other. However, at least two very important questions remain. First, does exposure to violence *cause* violent behaviour or desensitization to violence? Second, does early exposure to violence turn children into violent adolescents or adults? Unfortunately, there are no simple answers to either question, due in large part to investigators' reliance on correlational designs, which are typically used for studying long-term effects. Recall that correlational studies can establish only that variables are related, but cannot determine that one variable (media) causes another one (violent behaviour).

Another concern with these studies is that they aren't really examining *why* people respond aggressively when they see violent imagery. Although there is clearly a role for observational learning, a number of researchers have also suggested that people become desensitized to the violence and thus less likely to inhibit their own violent impulses. Recent brain imaging studies support this view. In one study, activity in parts of the frontal and parietal lobes showed reductions in activity as people became less sensitive to aggression shown in videos (Strenziok et al., 2011). In another experiment, participants with a low history of exposure to media violence showed more activity in frontal-lobe regions related to inhibiting responses than did participants who had more exposure to media violence and who had a history of aggressive behaviour. These differences were particularly strong when participants had to inhibit responses related to aggression-related words (Kalnin et al., 2011). Fans of North American football show reduced activity in brain regions associated with pain perception and empathy when viewing violent imagery (both specific to football and general violent themes) in comparison to non-fans (Daniel et al., 2018). Although these

studies don't definitively explain why media violence affects behaviour, they do point to at least one potential cause.

Why is this relevant?

If in fact media violence is a significant risk factor for future aggressiveness, then interventions that protect younger people are needed. Many organizations have stepped in to help parents make decisions about which type of media their children will be exposed to. The Motion Picture Association of America has been rating movies, with violence as a criterion, since 1968. (Canada does not have a national ratings system; individual provinces each rate movies.) Violence on television was being monitored and debated even before the film industry took this step. Since the 1980s, parental advisory stickers have been appearing on music with lyrics that are sexually explicit, reference drug use, or depict violence. Of course, as you know, these precautions have little effect on what children watch and listen to. Kids will always find a way to access this type of material. But, providing parents with more information about how these depictions of violence can affect children will hopefully highlight some of the dangers of these images and lyrics, and may inspire them to *talk to* their kids about how violence can be real. Doing so might teach children and adolescents to be better at examining whether media violence could be affecting their own behaviour.

Module 6.3 Summary

Listen to the Audio

6.3a Know . . . the key terminology associated with cognitive and observational learning.

Review Module 6.3

Start Over Swap

0/13 REVIEWED · 0 MASTERED

preparedness

Previous Next Got It!

6.3b Understand . . . the concept of latent learning and its relevance to cognitive aspects of learning.

Without being able to observe learning directly, it might seem as if no learning occurs. However, Tolman and Honzik showed that rats can form cognitive maps of their environment. They found that even when no immediate reward was available, rats still learned about their environment.

6.3c Apply . . . principles of observational learning outside of the laboratory.

Apply Activity

Based on what you have read in this module, how would you use observational learning in each of these settings? Are you simply letting people observe your behaviour, or does your plan involve elements learned in other modules in this chapter (e.g., shaping)?

Reset Next

6.3d Analyze . . . the claim that viewing violent media increases violent behaviour.

Psychologists agree that observational learning occurs and that media can influence behaviour. Many studies show a correlational (noncausal) relationship between violent media exposure and aggressive behaviour. Also, experimental studies, going all the way back to Albert Bandura’s

work in the 1960s, indicate that exposure to violent media can at least temporarily increase aggressive behaviour.

Chapter 7
Memory

Listen to the Audio

7.1 Memory Systems
- The Atkinson-Shiffrin Model
- Working the Scientific Literacy Model: Distinguishing Short-Term from Long-Term Memory Stores
- The Working Memory Model: An Active STM System
- Long-Term Memory Systems: Declarative and Nondeclarative Memories
- The Cognitive Neuroscience of Memory
- Module 7.1 Summary

7.2 Encoding and Retrieving Memories
- Encoding and Retrieval
- Working the Scientific Literacy Model: Context-Dependent Memory
- Emotional Memories
- Forgetting and Remembering
- Module 7.2 Summary

7.3 Constructing and Reconstructing Memories

How Memories Are Organized and Constructed

Working the Scientific Literacy Model: How Schemas Influence Memory

Memory Reconstruction

Module 7.3 Summary

Module 7.1 Memory Systems

Listen to the Audio

Jsemeniuk/E+/Getty Images

Learning Objectives

7.1a Know . . . the key terminology of memory systems.

7.1b Understand . . . which structures of the brain are associated with specific memory tasks and how the brain changes as new

memories form.

7.1c Apply . . . your knowledge of the neural basis of memory to predict what types of memory would be affected by damage to different areas of the brain.

7.1d Analyze . . . the claim that humans have multiple memory systems.

In October 1981, an Ontario man lost control of his motorcycle and flew off an exit ramp west of Toronto. He suffered a severe head injury and required immediate brain surgery in order to treat the swelling caused by the impact. Brain scans conducted after the accident showed extensive damage to the temporal lobes (including the hippocampus) as well as to both frontal lobes and the left occipital lobe. When the man, now known as patient K.C., recovered consciousness, doctors quickly noted that he had severe memory impairments. However, when psychologists from the University of Toronto dug deeper into K.C.'s condition, it became clear that he had retained some memory for general knowledge, but had lost his episodic memory, the memory of his specific experiences (Tulving et al., 1988). Strikingly, K.C. could recall the facts about his life (e.g., where he lived) but could not recall his personal experiences or feelings relating to those facts (e.g., sitting on the steps with friends).

K.C.'s devastating injuries helped researchers prove that we have several different types of memory, each involving different networks of brain areas (Rosenbaum et al., 2005). His case also hearkens back to a philosophical question posed by William James (1890–1950) over a century ago: If an individual were to awaken one day with their personal memories erased, would they still be the same person?

You have probably heard people talk about memory as if it were a single ability:

- I have a terrible memory!
- Isn't there some way I could improve my memory?

But have you ever heard people talk about memory as if it were several abilities?

- One of my memories works well, but the other is not so hot.

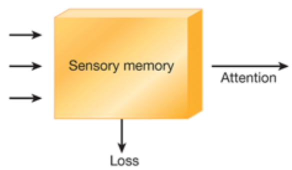
Probably not. However, as you will learn in this module, **memory** *is actually a collection of several systems that store information in different forms for differing amounts of time* (Atkinson & Shiffrin, 1968). One influential model for understanding these different systems, and the different types of memories they involve, can be seen in Figure 7.1.

The Atkinson-Shiffrin Model

Listen to the Audio

In the 1960s, Richard Atkinson and Richard Shiffrin reviewed what psychologists knew about memory at that time and constructed the memory model that bears their name (see Figure 7.1). The first thing to notice about the Atkinson-Shiffrin model is that it includes three memory stores (Atkinson & Shiffrin, 1968). **Stores** *retain information in memory without using it for any specific purpose*; they essentially serve the same purpose as hard drives serve for a computer. The three stores include sensory memory, short-term memory (STM), and long-term memory (LTM), which we will investigate in more detail later in this module. In addition, **control processes** *shift information from one memory store to another*. These are represented by the arrows in the model in Figure 7.1.

Figure 7.1 The Atkinson-Shiffrin Model



Let's apply the Atkinson-Shiffrin Model to a real-world example. Imagine that a student just moved to a new neighborhood and is looking for a place to grab some lunch. A pigeon zips in front of him and he flinches, so he **sensed** it, but he **doesn't pay attention** to it so the memory of the bird is lost in an instant.

1 of 5 Previous Next

Memory is a multistage process. Information flows through a brief sensory memory store into short-term memory, where rehearsal encodes it into long-term memory for permanent storage. Memories are retrieved from long-term memory and brought into short-term storage for further processing.

Source: Based on "Human Memory: A Proposed System and Its Control Processes" by in The Psychology of Learning and Motivation: Advances in Research and Theory, Vol 2 (pp. 89–195).

An important point illustrated in Figure 7.1 is that our memory systems, although stunningly powerful, are not perfect. We lose, or forget, information at each step of this model. Information enters the sensory memory store through all of the senses (e.g., vision, hearing, etc.), and the control process we call **attention** *selects which information will be passed on to STM*. This is highly functional: the attention process selects some elements of our environment that will receive further processing and add to our experience and understanding of the world. However, this functionality comes at a cost, because a vast amount of sensory information is quickly forgotten, almost immediately replaced by new

input. We selectively narrow the information we receive in STM even further through **encoding**, *the process of storing information in the LTM system*. We retain only some information and lose the rest. **Retrieval** *brings information from LTM back into STM*; this happens when you become aware of existing memories, such as remembering the movie you saw last week. Of course, this process is not perfect—we are sometimes unable to retrieve information when we want to. But, overall, our ability to retrieve information is astonishing. This interplay between remembering and forgetting is a theme that extends across all of the modules in this chapter. In this module, we are primarily concerned with the various types of memory stores, so we will examine each one in detail.

Sensory Memory

Listen to the Audio

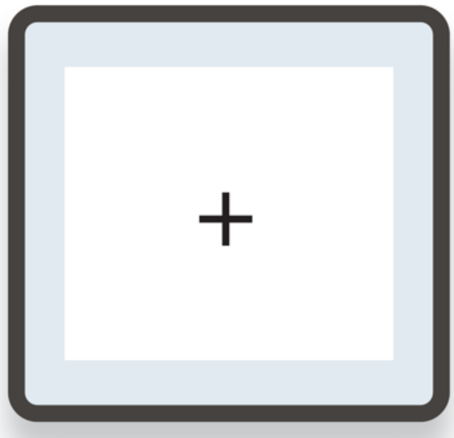
"What did I just say to you?" This sentence rarely leads to good things. It is generally spoken when one person in a conversation (e.g., a relationship partner) is apparently not paying attention to what another person (e.g., the other relationship partner) is saying. Individuals on the receiving end of this sentence often experience anxiety, if not a sense of doom. Luckily, we have a memory store that can sometimes come to the rescue.

Sensory memory *is a memory store that accurately holds perceptual information for a very brief amount of time*—how brief depends on which sensory system we talk about. **Iconic memory**, *the visual form of sensory memory*, is held for about one-half to one second. **Echoic memory**, *the auditory form of sensory memory*, is held for considerably longer, but still only for about 5–10 seconds (Cowan et al., 1990). It is this form of sensory memory that will allow you to repeat back the words you just heard, even though you may have been thinking about something else.

How much information can be held in sensory memory? This important question has proven very difficult to answer, because sensory memories—particularly visual memories—disappear faster than an individual can report them. George Sperling (1960) devised a brilliant method for testing the storage capacity of iconic memory. In his experiment, researchers flashed a grid of letters on a screen for a fraction of a second (Figure 7.2), and participants were asked to report what they saw. In the *whole*

report condition, participants attempted to recall as many of the letters as possible—the *whole* screen. Participants were generally able to report only three or four of the letters, and these would usually be in the same line. But does this mean that the iconic sensory memory system can only store three or four bits of information at a time? Sperling thought that it likely had a larger capacity, but hypothesized that the memory of the letters actually faded faster than participants could report them. To test this, in the *partial report* condition, participants were again flashed a set of letters on the screen, but the display was followed immediately by a tone that was randomly chosen to be low, medium, or high (Figure 7.2). After hearing the tone, participants were to report the corresponding line of letters—bottom, middle, or top. Under these conditions, participants still reported only three or four of the letters, but they reported them from the row indicated by the tone. Because the tone came after the screen went blank, the only way the participants could get the letters right is if all of the letters were (temporarily) stored in sensory memory. Thus Sperling argued that iconic memory could hold all 12 letters as a mental image, but that they would only remain in sensory memory long enough for a few letters to be reported.

Figure 7.2 A Test of Iconic Sensory Memory



George Sperling developed the following technique as a way of measuring iconic sensory memory. To begin, participants focused on a cross in the middle of a screen.

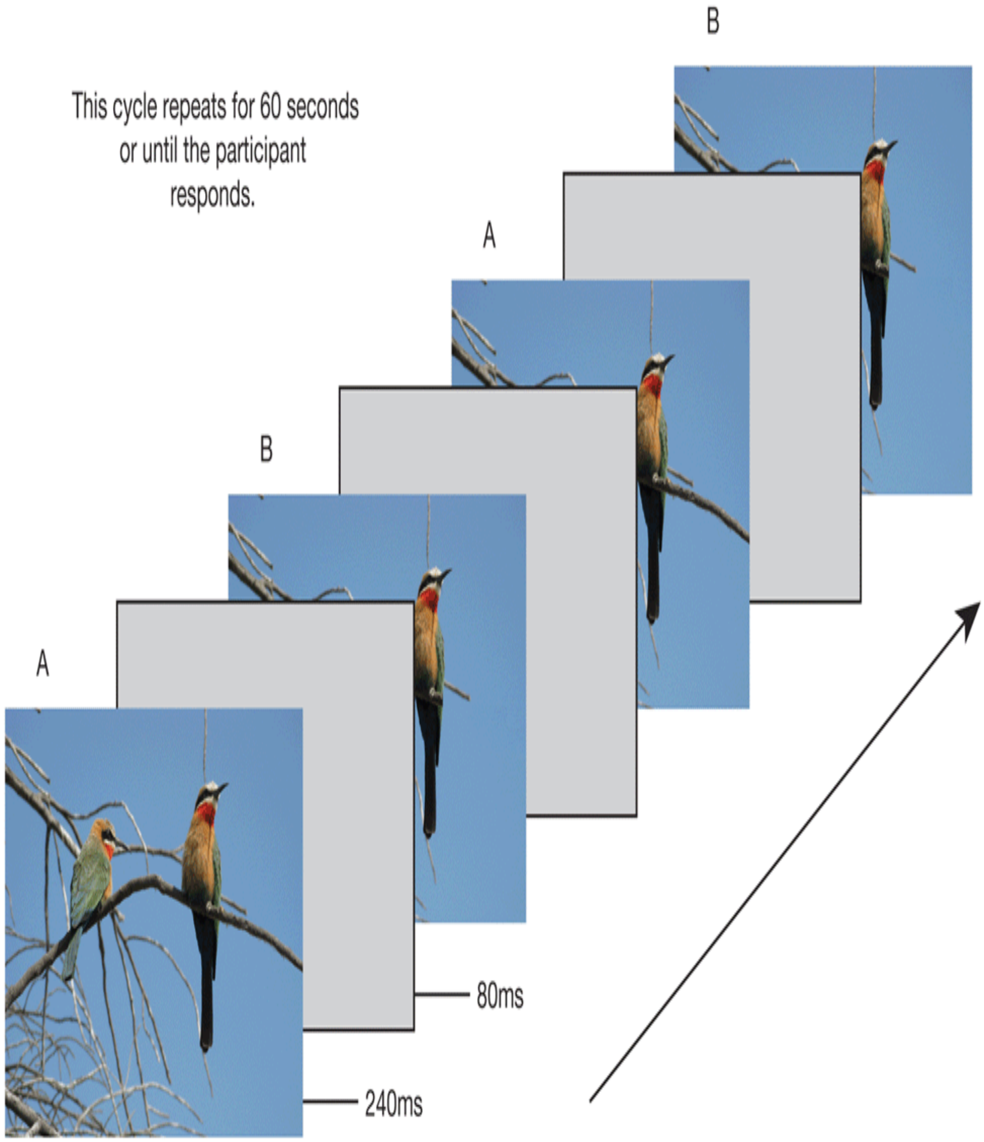
1 of 6 Previous Next

But if information in our sensory memory disappears after half a second, then how can we have any continuous perceptions? How can you stare meaningfully into someone's eyes without that person fading away from memory half a second after you look away, just like the letters in Sperling's experiment? The answer is attention. Attention allows us to move a small amount of the information from our sensory memory into STM for further processing. This information is often referred to as being within the "spotlight of attention" (Pashler, 1998). Information that is outside of this spotlight of attention is not transferred into STM and is unlikely to be remembered.

The relationship between sensory memory and attention is beautifully illustrated by a phenomenon known as *change blindness* (Rensink et al., 1997, 2000; Simons & Levin, 1997). In a typical change blindness experiment, participants view two nearly identical versions of a photograph (or some other stimulus); these stimuli will have only one

difference between them (e.g., a car is different colours in the two photographs). The goal on each trial of the experiment is to locate the difference (see Figure 7.3). However, the way in which the images are displayed presents quite a challenge. The two versions of the photograph are alternately presented for 240 ms each, with a blank screen in between them. So, a participant would see Photograph 1, blank screen, Photograph 2, blank screen, Photograph 1, blank screen, and so on. If the item that differs between the two photographs (e.g., the car) is not the focus of attention, people generally fail to notice the change (hence the term *change blindness*). This is likely because the appearance of the blank screen in between the two photographs occupies sensory memory, thus making the memory of the previous photograph less accessible. However, if the participant is paying attention to that changing element (i.e., the spotlight of attention is focused on that part of the image), the image of the first version of that item will be transferred into STM when the second, changed version appears on the screen. The difference between the two photographs then becomes apparent.

Figure 7.3 Change Blindness, Attention, and Sensory Memory



In change blindness, the sensory memory of photograph A disappears before the onset of photograph B, making it difficult to identify the difference between the two pictures. However, if a person is paying attention to the area that differs between the two photographs, then the representation of that part of the first photograph will still be in short-term memory when the second photograph appears, thus making it relatively easy to spot the change. In this example, part of a tree branch disappears in photograph B.

Source: Based on Rensink, R. A., O'Regan, J. K., & Clark, J. J. (1997). To see or not to see: The need for attention to perceive changes in scenes. *Psychological Science, 8*, 368–373. (Figure 1, p. 369). **Image:** Steve Smith.

An obvious question that arises is: Why don’t people quickly move their spotlight of attention around so that they can transfer all of their sensory memory into short-term memory? Unfortunately, there is a limit to how much information can be transferred at once (Marois & Ivanoff, 2005).

Short-Term Memory and the Magical Number 7

Listen to the Audio

Although transferring information from sensory memory into short-term memory increases the chances that this information will be remembered later, it is not guaranteed. This is because **short-term memory (STM)** is *a memory store with limited capacity and duration (approximately 30 seconds)*. The capacity of STM was summed up by one psychologist as "The Magical Number Seven, Plus or Minus Two" (Miller, 1956). In his review, Miller found study after study in which participants were able to remember seven units of information, give or take a couple. One researcher made the analogy between STM and a juggler who can keep seven balls in the air before dropping any of them. Similarly, STM can rehearse only seven units of information at once before forgetting something (Nairne, 1996).

This point leads to an important question: What, exactly, is "a unit of information"? The answer is not as straightforward as one might expect. It turns out that, whenever possible, we expand our memory capacity with **chunking**, *organizing smaller units of information into larger, more meaningful units*. These larger units are referred to as *chunks*. Consider these examples:

1. B T N C H C V N T C N S N C
2. C B C H B O C T V T S N C N N

If we randomly assigned one group of volunteers to remember the first list, and another group to remember the second list, how would you expect the two groups to compare? Look carefully at both lists. List 2 is easier to remember than list 1. Volunteers reading list 2 have the advantage of being able to apply patterns that fit their background knowledge; specifically, they can chunk these letters into five groups based on popular television networks:

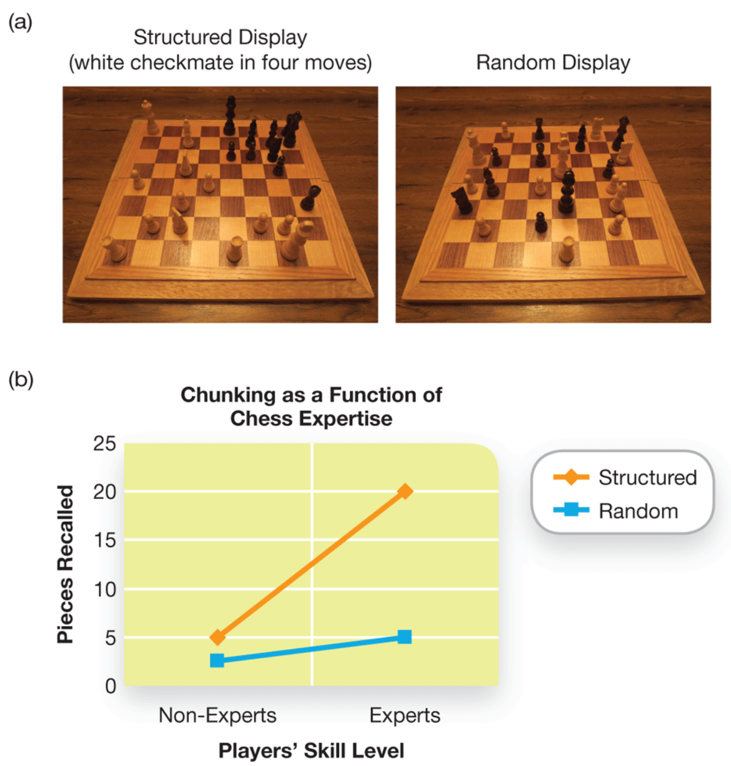
1. CBC HBO CTV TSN CNN

In this case, chunking reduces 15 bits of information to a mere five. We do the same thing with phone numbers. We turn the area code (236) into one chunk, the first three numbers (555) into another chunk, and then the final four numbers into one or two chunks depending upon the numbers (e.g., 1867 might be one chunk because it can be remembered as the year Canada became a country, while 8776 could be remembered as two chunks representing the jersey numbers for hockey players Sidney Crosby and P. K. Subban or, if you're not a hockey fan, some other meaningful pattern).

The ability to chunk material varies from situation to situation. If you had never watched television, then the five chunks of information in the example above wouldn't be very meaningful to you. This suggests that experience or expertise plays a role in our ability to chunk large amounts of information so that it fits into our STM. Studies of chess experts have confirmed that this is the case. Whereas most people would memorize the positions of chess pieces on a board individually, chess masters perceive it as a single unit, like a photograph of a scene (Chase & Simon, 1973; Gobet & Simon, 1998). Therefore, they are able to remember the positions of significantly more chess pieces than novices can. Of course, chunking only works when the chess pieces are aligned in meaningful chess positions; when they are randomly placed on the board, the

experts' memory advantage disappears (see Figure 7.4). Chunking also allows the chess masters to envision what the board will look like after future moves, again providing them with an edge over novices.

Figure 7.4 Chunking in Chess Experts



Chess experts have superior STM for the locations of pieces on a chess board due to their ability to create STM chunks. This advantage only occurs when the pieces are placed in a meaningful way, as they would appear in a game. (a) A depiction of a board with the pieces placed as they would appear in a game (left) and pieces placed in random locations (right). (b) The difference in STM for meaningful vs. randomly placed pieces increased as a function of the test subject's chess experience.

Source: Based on Gobet, F., Lane, P. C. R., Croker, S., Cheng, P. C. H., Jones, G., Oliver, I., & Pine, J. M. (2001). Chunking mechanisms in human learning. *TRENDS in Cognitive Sciences*, *5*(6), 236–243. (Figure 1, p. 237). **Image:** Steve Smith.

Importantly, this expertise is not necessarily based on some innate talent; it can be learned through intensive practice. The most stunning confirmation of this view comes from the Polgár sisters of Budapest,

Hungary (Flora, 2005). Their father, Lázló Polgár, decided before they were born that he was going to raise them to become chess grandmasters. Doing so would confirm his belief that anyone could be trained to become a world-class expert in any field if they worked hard enough (he was not a grandmaster himself). Polgár trained his daughters in the basics of chess, and had them memorize games so that they could visualize each move on the board. After thousands of hours of what amounts to "chunking training," the girls (who, luckily, enjoyed chess) rose to the top of the chess world. The eldest daughter, Susan, became the first female to earn the title of Grandmaster through tournament play. The youngest daughter, Sofia, is an International Master. The middle daughter, Judit, is generally thought of as the best female chess player in history.

Long-Term Memory

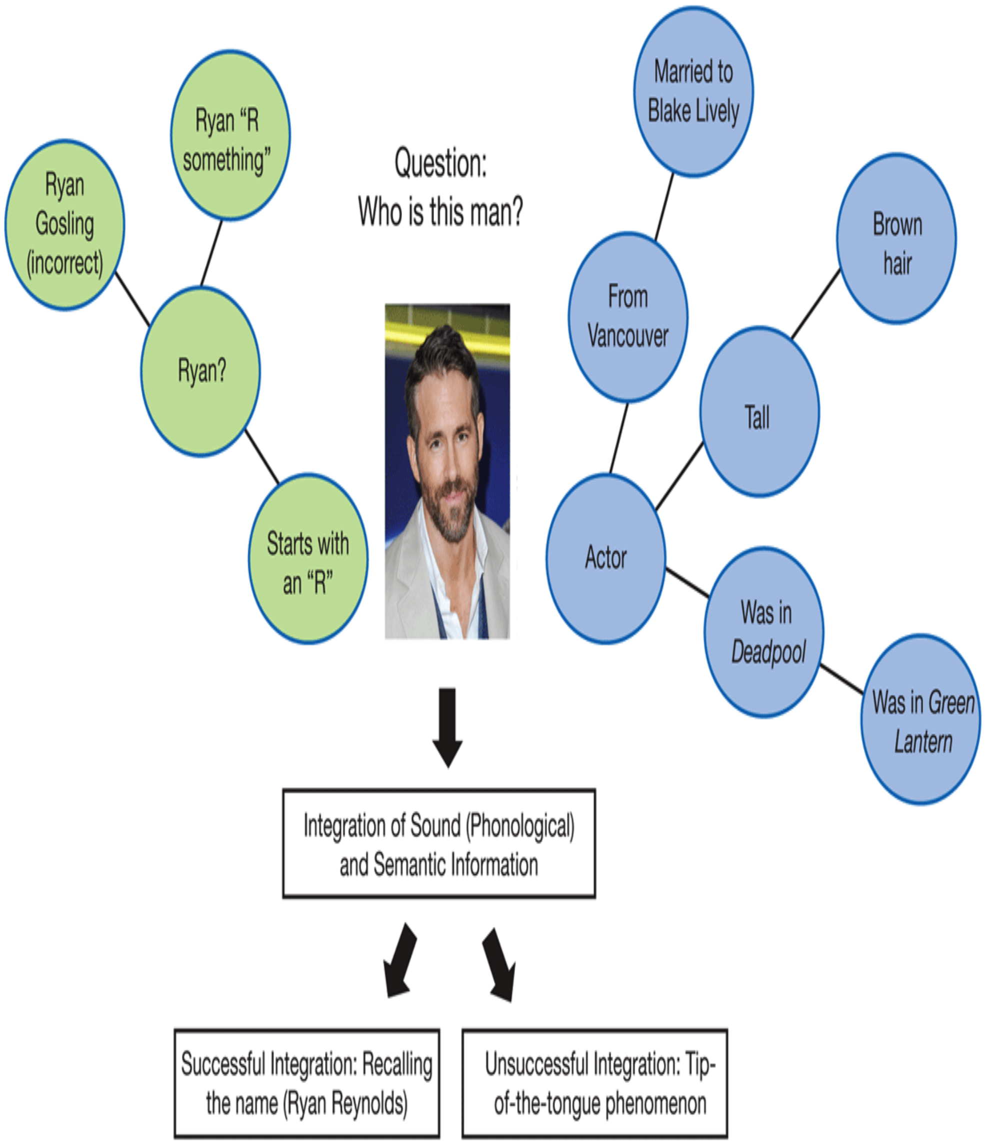
Listen to the Audio

Not all of the information that enters STM is retained. A large proportion of it is lost forever. This isn't necessarily a bad thing, however. Imagine if every piece of information you thought about remained accessible in your memory. Your mind would be filled with phone numbers, details from text messages, images from billboards and ads on buses, as well as an incredible amount of trivial information from other people (e.g., overhearing the coffee order of the person in front of you). Instead, only a small amount of information from STM is encoded or transformed into a more permanent representation that we can intentionally access later on. Encoding allows information to enter the final memory store in the Atkinson-Shiffrin model. This store, **long-term memory (LTM)**, *holds information for extended periods of time, if not permanently*. Unlike short-term memory, long-term memory has no capacity limitations (that we are aware of). All of the information that undergoes encoding will be entered into LTM.

Once entered into LTM, the information needs to be organized. Researchers have identified at least two ways in which this organization occurs. One way is based on the semantic categories that the items belong to (Collins & Loftus, 1975). The mental representation of *cat* would be connected to and stored near the mental representation of other animals such as *dog* and *mouse*. This model is consistent with the results from an interesting experiment from the 1950s. Participants were asked to remember a list of 60 words that were drawn from four different

categories. Although the words were randomly presented, participants recalled them in semantically related groups (e.g., lion, tiger, cheetah . . . guitar, violin, cello, etc.). This research suggests that semantically related items are stored near each other in LTM (see Module 8.1). A second way that LTM is organized is based on the sounds of the word and on how the word looks. This explains part of the **tip-of-the-tongue (TOT) phenomenon**, *when you are able to retrieve similar sounding words or words that start with the same letter but can't quite retrieve the word you actually want* (Brown & McNeil, 1966). What appears to be happening in these situations is that nearby items, or nodes, in your neural network are activated (see Figure 7.5).

Figure 7.5 The Tip-of-the-Tongue Phenomenon and the Organization of Memory



Long-term memory is often stored in networks. Activating one node in the network such as *cat* also makes related items (e.g., *dog*) more available in memory. In the tip-of-the-tongue phenomenon, a node that is similar to the word that an individual is trying to retrieve is activated. Sometimes, this activation will allow a person to retrieve the target word. In other times, it leads to frustration (and occasionally cursing).

Of course, having the information in LTM doesn't necessarily mean that you can access it when you want to. If that were the case, then you would never forget where you put your keys, and no one would be impressed by your knowledge of Harry Potter trivia. Instead, the likelihood that a given

piece of information will undergo retrieval—the process of accessing memorized information and returning it to short-term memory—is influenced by a number of factors including the quality of the original encoding and the strategies used to retrieve the information. These important processes are described in depth later in this text.

The Atkinson-Shiffrin Model provides a very good introduction to the different stages of memory formation. However, memory is much more complex than is implied by this box-and-arrow diagram. Throughout the rest of this module, we will move beyond the Atkinson-Shiffrin Model to examine more complex and nuanced aspects of human memory. In the next section, we will discuss working memory, a sophisticated form of STM that involves a number of different, complementary, pieces.

Working the Scientific Literacy Model

Distinguishing Short-Term from Long-Term Memory Stores

Listen to the Audio

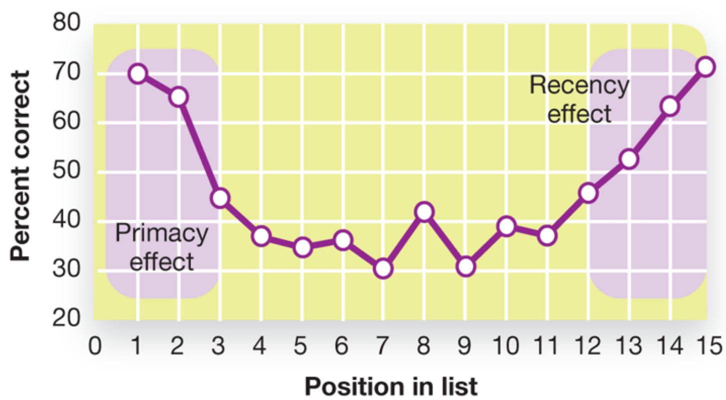
The Atkinson-Shiffrin model of memory is very neat and tidy, with different memory stores contained in separate boxes. The problem is that the real world rarely involves 30-second blocks of time filled with 7 ± 2 pieces of information followed by a short break to encode them. Instead, we are often required to use both STM and LTM at the same time. Without this ability, we wouldn't be able to have conversations, nor would we be able to understand paragraphs of text like this one. So, if STM and LTM are constantly working together, how do we isolate the functions of each memory store?

What do we know about short-term and long-term memory stores?

As you'll recall (thanks to your LTM), STM lasts for approximately 30 seconds and usually contains 7 ± 2 units of information; LTM has no fixed time limits or capacity. The distinction between STM and LTM can be revealed with a simple experiment. Imagine a group of people studied a list of 15 words and then immediately tried to recall the words in the list. The serial position curve—the U-shaped graph in Figure 7.6—shows what the results would look like according to the **serial position effect**: *In general, most people will recall the first few items from a*

list and the last few items, but only an item or two from the middle (Ebbinghaus, 1885/1913). This finding holds true for many types of information, ranging from simple strings of letters to the ads you might recall after watching the Super Bowl (Laming, 2010; Li, 2010).

Figure 7.6 The Serial Position Effect



Memory for the order of events is often superior for original items (the primacy effect) and later items (the recency effect). The serial position effect provides evidence of distinct short-term and long-term memory stores.

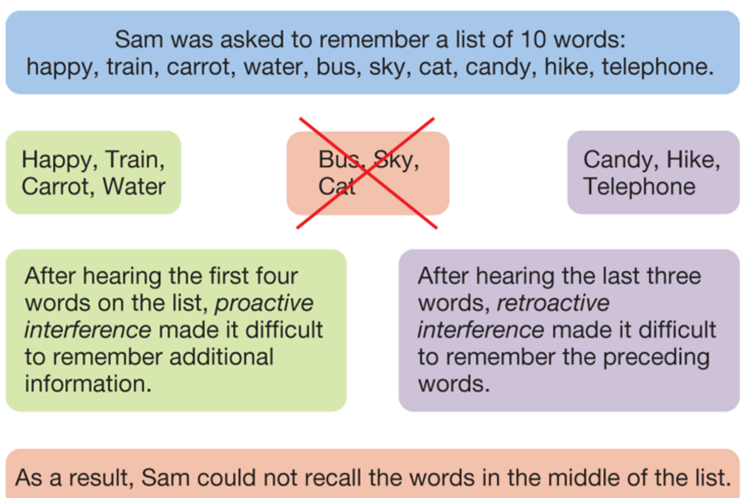
The first few items are remembered relatively easily (known as the *primacy effect*) because they have begun the process of entering LTM. The last few items are also remembered well (known as the *recency effect*); however, this is because those items are still within our STM (Deese & Kaufman, 1957). The fate of the items in the middle of the test is more difficult to determine, as they would be in the process of being encoded into LTM. As you have already read, some information is lost during this process.

How can science explain the difference between STM and LTM stores?

The shape of the serial position effect (see Figure 7.6) suggests that there are two processes at work. But how do we explain the dip in the middle of the curve? Memory researchers suggest that this dip in performance is caused by two mechanisms. First, the items that were at the beginning of the list produce **proactive interference**, *a process in which the first information learned (e.g., in a list of words) occupies memory, leaving fewer resources left to remember the newer information*. The last few items on the list create **retroactive interference**—that is, *the most recently learned information overshadows some older memories that have not yet made it into long-term memory* (see Figure 7.7). Together, these two types of interference would result in poorer memory performance for items in the middle of a list.

Figure 7.7

Proactive and Retroactive Interference Contribute to the Serial Position Effect



In addition to demonstrating behavioural differences between STM and LTM, scientists have also used neuroimaging to attempt to identify the different brain regions responsible for each form of memory. Deborah Talmi and colleagues (2005) at the University of Toronto performed an fMRI experiment in which they asked

10 volunteers to study a list of 12 words presented one at a time on a computer screen. Next, the computer screen flashed a word and the participants had to determine whether the word was from their study list. The researchers were mostly concerned about the brain activity that occurred when the volunteers correctly recognized words. When volunteers remembered information from early in the serial position curve, the *hippocampus* was active (this area is associated with the formation of LTM, as you will read about later). By comparison, the brain areas associated with sensory information—hearing or seeing the words—were more active when people recalled items at the end of the serial position curve. Thus, the researchers believed they had isolated the effects of two different neural systems that, working simultaneously, produce the serial position curve.

Can we critically evaluate the distinction between STM and LTM?

In order to evaluate the idea that the serial-position effect is caused by two interacting memory systems, we need at least two types of tests. First, we need to find evidence that it is possible to change the performance on one test but not the other. Then we need to find medical cases in which brain damage affected one system but not the other. Together, these findings would support the view that STM and LTM stores can be distinguished from each other.

The fact that it is possible to separately affect the primacy and recency effects was demonstrated in the 1950s and 1960s. When items on a list are presented quickly, it becomes more difficult to completely encode those items into long-term memory. The result is a reduction in the primacy effect; however, STM will still contain the most recently presented items, thus leaving the recency effect unchanged (Murdock, 1962). The recency effect

can be reduced by inserting a delay between the presentation of the list and the test. This delay will allow other information to fill up STM; LTM, as shown by the primacy effect, will be unaffected (Bjork & Whitten, 1974).

Evidence from neurological patients also supports the distinction between STM and LTM. STM deficits can occur after damage to the lower portions of the temporal and parietal lobes, as well as to lateral (outside) areas of the frontal lobes (Müller & Knight, 2006). In contrast, damage to the hippocampus will prevent the transfer of memories from STM to LTM (Scoville & Milner, 1957). These patients will have relatively preserved memories of their past, but will be unable to add to them with new information from short-term memory.

Why is this relevant?

The idea of multiple memory stores is theoretically interesting and can explain some of the minor memory problems we all experience (e.g., forgetting parts of a phone number). But being able to distinguish between STM and LTM has more wide-reaching implications. The fact that it is possible to separate STM and LTM—and that these stores are driven by different brain systems—suggests that you could use simple tests like the serial-position effect to predict where a neurological patient's brain damage had occurred. Many common assessment tools such as the Wechsler Memory Scales (Wechsler, 2009) include tests of both types of memory in order to do just that. Clues uncovered by these initial assessment tests can be used by emergency room physicians and neurologists to assist with their diagnoses and may lead them to request a brain scan for a patient (to look for damage) when they might not otherwise have done so.

The Working Memory Model: An Active STM System

Listen to the Audio

Imagine you are driving a car when you hear the announcement for a radio contest—*the 10th person to call 1-800-555-HITS will win an all-expenses paid trip to Costa Rica!* As the DJ shouts out the phone number, panic sets in. You desperately want this prize, but you're driving—and traffic is swarming. What do you do? As you try to pull over to the side of the road as quickly as you can, you will probably try to remember the number by using **rehearsal**, *or repeating information* (in this case, the number) *until you do not need to remember it anymore*. Psychological research, however, demonstrates that remembering is much more than just repeating words to yourself (see Module 7.2). Instead, keeping information like the radio station's phone number available is an active process that is much more complex than one would expect.

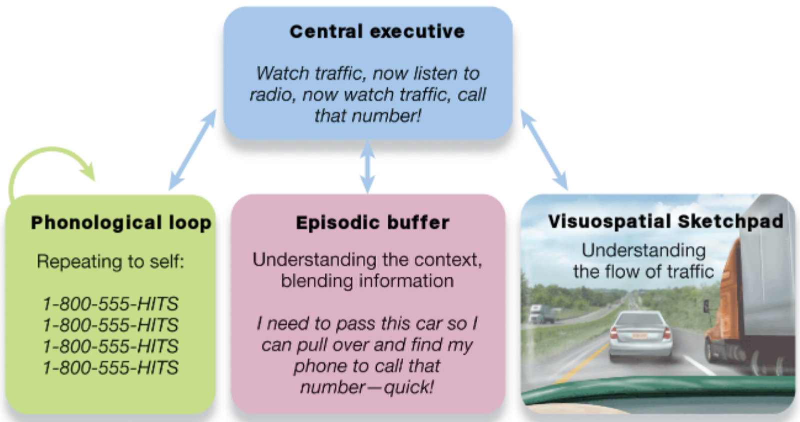
According to the Atkinson-Shiffrin model of memory, you would attempt to retain the phone number in STM, possibly transferring it to LTM. This process would go smoothly if no other information entered STM, and if traffic cooperated so that you didn't really have to attend to anything other than the phone number. Of course, the world is rarely that simple. Indeed, in the 1970s, psychologists led by Alan Baddeley suggested that a slightly more complex model of memory was required, one that better explained how memory relates to our moment-to-moment conscious experiences (Baddeley & Hitch, 1974). The result was a theory of **working memory**, *a model of short-term remembering that includes a*

combination of memory components that can temporarily store small amounts of information for a short period of time.

A key feature of working memory is that it recognizes that stimuli are encoded simultaneously in a number of ways, rather than simply as a single unit of information. The classic working memory model for short-term remembering can be subdivided into three storage components (Figure 7.8), each of which has a specialized role (Baddeley, 2001; Jonides et al., 2005): the phonological loop, the visuospatial sketchpad, and the episodic buffer. In the example above, the auditory information from the DJ needs to be remembered so that you can win the trip to Costa Rica (phonological loop). Visual information needs to be remembered so that you can keep track of the traffic patterns while you drive (visuospatial sketchpad). And while you are juggling these bits of information, you are also linking them together into a mental narrative or story about how you had to pull your car over to try to win an exotic vacation (episodic buffer). These storage components are then coordinated by a control centre known as the *central executive*. The central executive helps decide which of the working-memory stores is most important at any given moment (e.g., remembering the phonological information of the phone number). It can also draw from older information that is stored in a relatively stable way to help organize or make sense of the new information.

Figure 7.8 Components of Working Memory Work Together to Manage Complex Tasks

Study the chart, then select Start Challenge when you're ready.



Start Challenge

As you can see, working memory provides a more nuanced model of short-term memory processes than the Atkinson-Shiffrin model (Cowan, 2008). But is all this additional complexity necessary? Below, we will discuss this model in more detail and show how various research findings support this more complex understanding of memory.

The Phonological Loop

Listen to the Audio

The **phonological loop** *is a storage component of working memory that relies on rehearsal and that stores information as sounds, or an auditory code*. It engages some portions of the brain that specialize in speech and hearing, and it can be very active without affecting memory for visual and spatial information. At first glance, it appears similar to the STM store of the Atkinson-Shiffrin model; however, a simple experiment will show you how it differs. Earlier in this module, you read about the magical number 7, the finding that the capacity of STM is generally 7 ± 2 items. However, research into the **word-length effect** has shown that *people remember more one-syllable words* (sum, pay, bar, . . .) *than four- or five-syllable words (*helicopter, university, alligator, . . .) *in a short-term-memory task* (Baddeley et al., 1975). Psychologists have found that working memory can only store as many syllables as can be rehearsed in about two seconds, and that this information is retained for approximately 15 to 30 seconds (Brown, 1958; Peterson & Peterson, 1959). So, in the radio-contest example, you would likely be able to remember the phone number (it can be spoken in under two seconds), but you would need to pull over to use your phone fairly quickly, before the information started to fade away.

Some readers might wonder how the word-length effect and chunking (discussed earlier in this module) can both affect memory. According to early models of chunking, long words like *helicopter* and *alligator* and short words like *bar* and *pay* would all be one chunk, whereas the word-length effect suggests that fewer long words would be remembered.

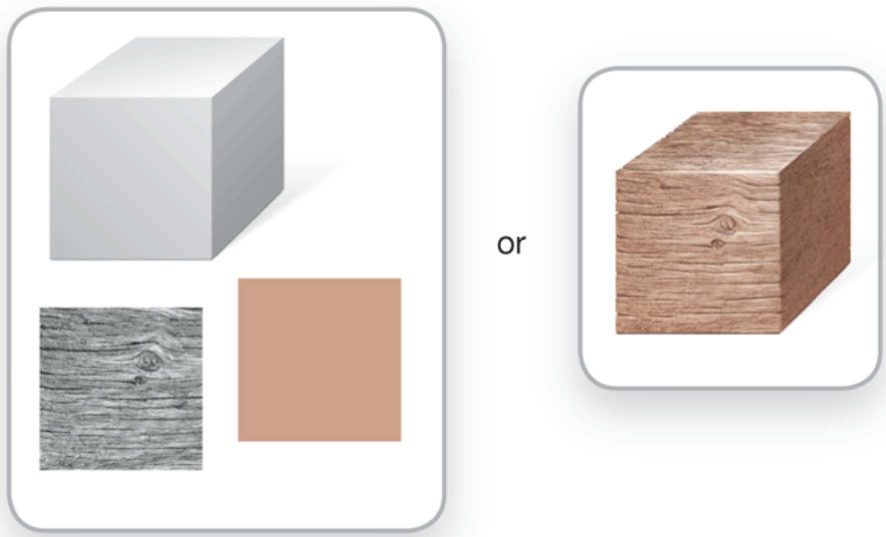
Which view is correct? As it turns out, both *can* be correct, depending upon how memory is tested. If participants are allowed to recall information in any order, chunking appears to be an important factor. If participants have to recall the information in a particular order, then the length of the stimuli limits memory (Chen & Cowan, 2005). In the case of remembering the phone number of the radio station in our example, the order of the numbers would obviously be a critical factor.

The Visuospatial Sketchpad

Listen to the Audio

The **visuospatial sketchpad** *is a storage component of working memory that maintains visual images and spatial layouts in a visuospatial code*. It keeps you up to date on where objects are around you and where you intend to go. To do so, the visuospatial sketchpad engages portions of the brain related to the perception of vision and space and does not affect memory for sounds. Just as the phonological store can be gauged at several levels—that is, in terms of the number of syllables, the number of words, or the number of chunks—items stored in visuospatial memory can be counted based on visual features such as shape, colour, and texture. This leads to an important question: How are these different visual features processed by the visuospatial sketchpad? Do different types of features (e.g., colour vs. shape) get stored separately, or are they integrated into one chunk? For example, would a smooth, square-shaped, red block count as one chunk or three? Research has consistently shown that a square-shaped block painted in two colours is just as easy to recognize as the same-shaped block painted in one colour (Vogel et al., 2001). Therefore, visuospatial working memory may use a form of chunking known as **feature binding**, *the process of combining visual features into a single unit* (see Figure 7.9).

Figure 7.9 Working Memory Binds Visual Features into a Single Chunk



Working memory sometimes stores information such as shape, colour, and texture as three separate chunks, like the three pieces of information on the left. For most objects, however, it stores information as a single chunk, like the box on the right.

After visual feature binding, visuospatial memory can accurately retain approximately four whole objects, regardless of how many individual features one can find on those objects. Perhaps this is evidence for the existence of a second magical number—four (Awh et al., 2007; Vogel et al., 2001).

To put feature binding into perspective, consider the amount of visual information available to you when you are driving a car, as in the story that started this section. If you are at the wheel, watching traffic, you probably would not look at a car in front of you and remember images of red, shiny, and smooth. Instead, you would simply have these features bound together in the image of the car, and you would be able to keep track of three or four such images without much problem as you glance at the speedometer and then back to the traffic around you. It is also possible that you might group together several cars into one visual chunk

(e.g., the six cars you can see directly in front of you); it is likely that our expertise with situations will allow us to alter the size of the chunks in this component of working memory.

The Episodic Buffer

Listen to the Audio

Recent research suggests that working memory also includes an **episodic buffer**—that is, *a storage component of working memory that combines the images and sounds from the other two components into coherent, story-like episodes*. These episodes allow you to organize or make sense of the images and sounds, such as "I was driving to a friend's house when I heard the radio DJ give a number to call."

The episodic buffer is the most recently hypothesized working memory system (Baddeley, 2001). It seems to hold seven to 10 pieces of information, which may be combined with other memory stores. This aspect of its operation can be demonstrated by comparing memory for prose (words strung into sentences) to memory for unrelated words. When people are asked to read and remember meaningful prose, they usually remember seven to 10 *more* words than when reading a random list of unrelated words. Some portion of working memory is able to connect the prose with information found in LTM (i.e., knowledge about the topic of the story) to increase memory capacity.

The Central Executive

Listen to the Audio

Finally, working memory includes one component that is not primarily used for storing information. Instead, the **central executive** *is the control centre of working memory; it coordinates attention and the exchange of information among the three storage components*. It does so by examining what information is relevant to the person's goals, interests, and prior knowledge and then focusing attention on the working memory component whose information will be most useful in that situation. For example, when you see a series of letters from a familiar alphabet, it is easy to remember the letters by rehearsing them in the phonological loop. In contrast, if you were to look at letters or characters from a unfamiliar alphabet, you may not be able to convert them to sounds; thus you would assign them to the visuospatial sketchpad instead (Paulesu et al., 1993). Regions within the frontal lobes of the brain are responsible for carrying out these tasks for the central executive.

Working Memory: Putting the Pieces Together

Listen to the Audio

Thus far, we've talked about the different pieces of working memory as separate functions. In reality, however, these pieces would work together to influence what information you are able to remember. So how do these four components of the working-memory system work for you when you cannot pull your car over immediately to place the 10th call to win the trip to Costa Rica? Most of us would rely on our phonological loop, repeating the number 1-800-555-HITS to ourselves until we can call. Meanwhile, our visuospatial sketchpad is remembering where other drivers are in relation to our car, even as we look away to check the speedometer, the rearview mirror, or the volume knob. Finally, the episodic buffer binds together all this information into episodes, which might include information such as "I was driving to school," "the DJ announced a contest," and "I wanted to pull over and call the station." In the middle of all this activity is the central executive, which guides attention and ensures that each component is working on the appropriate task. So, if a bus suddenly changed lanes in front of you, the central executive would focus more on the visuospatial sketchpad until you were sure that you were safe; then it would again focus on the phonological loop. Thus, although your memories often seem almost automatic, there is actually a lot of activity being performed by your working memory.

Long-Term Memory Systems: Declarative and Nondeclarative Memories

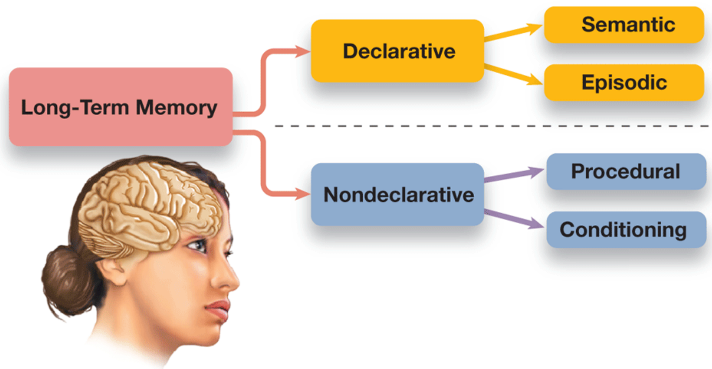
Listen to the Audio

Figure 7.1 at the beginning of this module suggests that humans have just one type of long-term memory (LTM). However, as you read in the story about the neurological patient K.C., LTM has a number of different components. K.C. could learn new skills, draw maps, and remember basic facts. Yet, he was unable to recall specific episodes in his own life (Tulving & Markowitsch, 1998). What do cases like K.C.'s tell us about the organization of LTM?

One way to categorize LTM is based on whether or not we are conscious of a given memory (see Figure 7.10). Specifically, **declarative memories (or explicit memories)** *are memories that we are consciously aware of and that can be verbalized, including facts about the world and our own personal experiences;* an easy way to remember this is that declarative memories are, handily, about things we can *declare*. In contrast, **nondeclarative memories (or implicit memories)** *include actions or behaviours that you can remember and perform without awareness*; that is, these are memories about things that we cannot *declare*. But, this initial division only scratches the surface of LTM's complexity. Both declarative and nondeclarative memories have multiple subtypes, each with its own characteristics and brain networks.

Figure 7.10

Varieties of Long-Term Memory



Long-term memory can be divided into different systems based on the type of information that is stored.

Declarative Memory

Listen to the Audio

Declarative memory comes in two varieties (Tulving, 1972). **Episodic memories** *are declarative memories for personal experiences that seem to be organized around "episodes" and are recalled from a first-person ("I" or "my") perspective*. Examples of episodic memories would be your first day of university, the party you went to last month, and that time you remember watching the Olympics on TV. **Semantic memories**, on the other hand, are *declarative memories that include facts about the world*. Examples of semantic memories would include knowing that Fredericton is the capital of New Brunswick, remembering that your mother's birthday is April 6, and that bananas are (generally) yellow. The two types of memory can be contrasted in an example: Your semantic memory is your knowledge of what a bike is, whereas episodic memory is the memory of a specific time when you rode a bike. It is worth clarifying that both episodic and semantic memory representations *can* be active at the same time. If someone asks you, "Can you ride a bike?" you will likely think of both semantic information about bikes as well as episodic instances in which you rode one. But there are also instances in which only one type of memory can be active, such as if someone asked you if you had ever been in a space shuttle. The term *space shuttle* would activate semantic memory, but unless you are one of the 10 Canadians who have been in space, it would not activate episodic memories of you staring down at our blue planet.

The case of K.C. provides compelling evidence that semantic and episodic memories are distinct forms of declarative memory. Although K.C. had no specific memories of events that took place in his high school or his house, he did understand that he had attended high school and that he lived in a specific home in Mississauga, Ontario. However, K.C. is not the only example of the distinction between these types of memory. Studies of older adults have noted that they show similar (but much less severe) impairments to K.C. on memory tests. As people get older, their episodic memory declines more rapidly than their semantic memory (Luo & Craik, 2008). Older people are more likely to forget going on vacation five years ago than they are to forget something like the names of provincial capitals (Levine et al., 2002). Interestingly, they also show normal performance on a number of tests related to nondeclarative memories.

Nondeclarative Memory

Listen to the Audio

Nondeclarative memory occurs when previous experiences influence performance on a task that does not require the person to intentionally remember those experiences (Graf & Schacter, 1985). The earliest published report of this form of memory came in 1845 when a British physician named Robert Dunn described the details of a woman with amnesia (Schacter, 1985). This woman learned how to make dresses following her injury, but had no conscious memory of learning to do so. A more pointed example was published in the early 20th century by Claparède (1911/1951). He reported on an amnesic woman who learned not to shake his hand because he had previously stuck her with a pin attached to his palm. In both cases, the behaviours of patients with no conscious memories were altered because of previous experiences, thus suggesting that this previous information was encoded into LTM in some form.

But nondeclarative memories are not isolated to cases of amnesia. You have thousands of nondeclarative memories in your brain right now. The best-known example of nondeclarative memory is **procedural memory**, *learned patterns of muscle movements (motor memory)* such as how to walk, play piano, tie your shoes, or drive a car. Once procedural memories are formed, we often don't think of the individual steps involved or even pay attention to the task, yet we execute them flawlessly most of the time.

A second example of nondeclarative memory is *classical conditioning*, when a previously neutral stimulus (e.g., the sound of a metronome) produces a new response (e.g., salivating) because it has a history of being paired with another stimulus that produces that response (e.g., food). Although these associations can sometimes be consciously recalled, this recollection is not necessary for conditioning to successfully take place (see Module 6.1).

Review Varieties of Long-Term Memory Challenge

Let's see if you can apply the varieties of long-term memory to a real-world example: piano playing. Study the table, then select "Check Your Understanding" to test your knowledge.

Example	Type of Memory Involved
Remembering how to play a song on the piano	procedural memory
Knowing what a piano is	semantic memory
Remembering going to piano lessons last week	episodic memory

Check Your Understanding

The Cognitive Neuroscience of Memory

Listen to the Audio

Many psychologists who are interested in memory examine it from a biological perspective, investigating how the nervous system changes with the formation of new memories. To explore the cognitive neuroscience of memory, we will take a brief look at the neuronal changes that occur as memories are forming and strengthening, and will then examine the brain structures involved in long-term storage. Finally, we will use examples from studies of amnesia and other forms of memory loss to understand how our memory models fit with biological data.

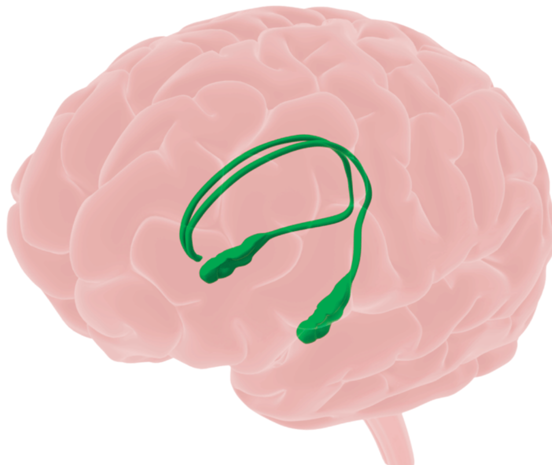
Memory at the Cellular Level

Listen to the Audio

Memory at the cellular level can be summed up in the following way: Cells that fire together, wire together. This idea was proposed in the 1940s by Canadian neuroscientist Donald Hebb. Specifically, he suggested that when neurons fire at the same time, it leads to chemical and physical changes in the neurons, making them more likely to fire together again in the future (Hebb, 1949). Later research proved Hebb correct, and demonstrated that changes occur across numerous brain cells as memories are forming, strengthening, and being stored (Lømo, 1966). This process, **long-term potentiation (LTP)**, *demonstrated that there is an enduring increase in connectivity and transmission of neural signals between nerve cells that fire together*.

The discovery of LTP occurred when researchers electrically stimulated two neurons in a rabbit's hippocampus—a key memory structure of the brain located in an area called the medial temporal lobes (see Figure 7.11). Stimulation of the hippocampus increased the number of electrical potentials from one neuron to the other. Soon, the neurons began to generate *stronger* signals than before, a change that could last up to a few hours (Bliss & Lømo, 1973). This finding does not mean that LTP *is* memory—no one has linked the strengthening of a particular synapse with a specific memory like your first day of university. In fact, no one has seen LTP outside of a laboratory. But the strengthening of synapses shown in LTP studies may be one of the underlying mechanisms that allow memories to form.

Figure 7.11 The Hippocampus

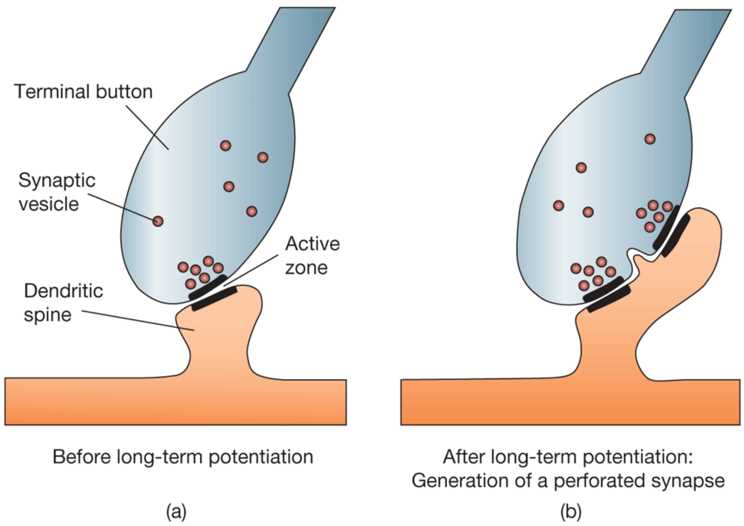


The hippocampus resides within the temporal lobe and is critical for memory processes.

This relationship is not permanent, however. Lasting memories require **consolidation**, *the process of converting short-term memories into long-term memories in the brain*, which may happen at the level of small neuronal groups or across the cortex (Abraham, 2006). When neurons fire together a number of times, they will adapt and make the changes caused by LTP more permanent—a process called *cellular consolidation*. This process involves physical changes to the synapse between the cells so that the presynaptic cell is more likely to stimulate a *specific* postsynaptic cell or group of cells (see Figure 7.12). Without the consolidation process, the initial changes to the synapse (LTP) eventually fade away, and presumably so does the memory. (This process can therefore be summed up with the saying: Use it or lose it.) To demonstrate the distinction between the initial learning and longer-term consolidation, researchers administered laboratory rats a drug that allowed LTP, but prevented consolidation from occurring (by blocking biochemical actions). The animals were able to learn a task for a brief period, but they were not able to form long-term memories. By comparison, rats in the placebo group, whose brains were able to consolidate the information, went through the

same tasks and formed long-term memories without any apparent problems (Squire, 1986).

Figure 7.12 Consolidation at the Synapse



Structural changes can occur at a synapse when a specific axon terminal on the presynaptic neuron consistently stimulates a specific dendrite on the post-synaptic neuron. These changes can help the process of memory consolidation.

The initial strengthening of synapses (LTP) and longer-term consolidation of these connections allow us to form new memories, thus providing us with an ability to learn and to adapt our behaviour based on previous experiences. However, these processes are not performed in all areas of the brain. Instead, specific structures and regions serve essential roles in allowing us to form and maintain our memories, a fact powerfully demonstrated by the memory deficits of patients with amnesia.

Memory, the Brain, and Amnesia

Listen to the Audio

On August 31, 1953, Henry Molaison was a 27-year-old man with intractable epilepsy. Because his seizures could not be controlled by medications, Mr. Molaison had been referred to Dr. William Scoville, a respected Hartford-based neurosurgeon, for treatment. Dr. Scoville and his colleagues had suggested that removing the areas of Molaison's brain that triggered the seizures would cure, or at least tame, his epilepsy. On September 1, 1953, Henry Molaison underwent a resection (removal) of his medial temporal lobes—including the hippocampus—on both sides of his brain. After that day, he became known to the world as neurological patient H.M.

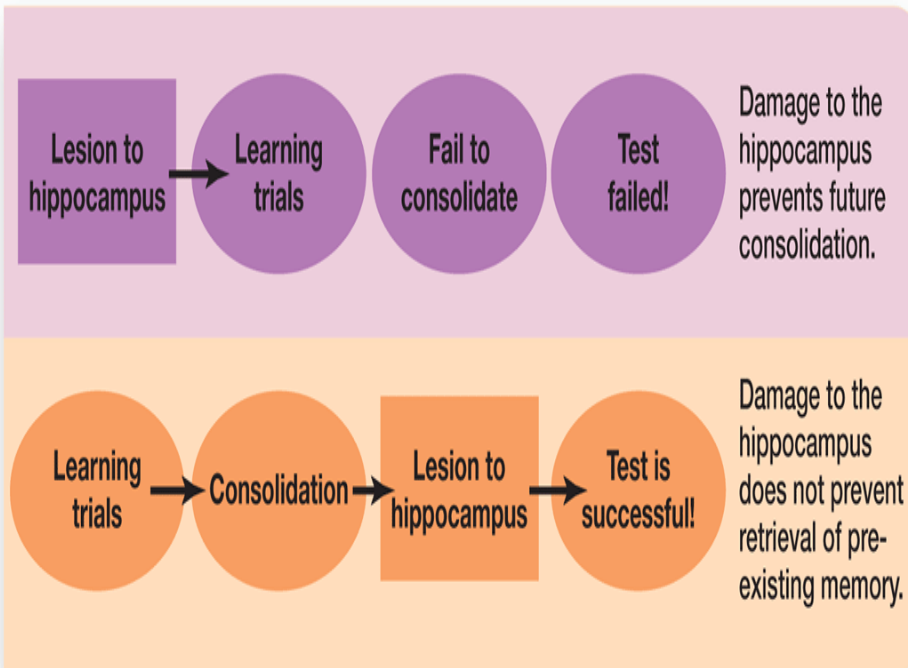
H.M.'s surgery was successful in that he no longer had seizures. However, as he recovered from his surgery, it became apparent that the procedure had produced some unintended consequences. The doctors quickly determined that H.M. had **amnesia**—*a profound loss of at least one form of memory*. However, not all of his memories were lost; in fact, numerous studies conducted by Brenda Milner of McGill University demonstrated that H.M. retained many forms of memory (Milner, 1962; Scoville & Milner, 1957). He was able to recall aspects of his childhood. He could also remember the names of the nurses who had treated him before the surgery, although he was unable to learn the names of nurses he met afterward. Indeed, H.M. appeared unable to encode new information at all. Therefore, H.M. was experiencing a specific subtype of

amnesia known as **anterograde amnesia**, *the inability to form new memories for events occurring after a brain injury*.

H.M.'s anterograde amnesia was not due to problems with his sensory memory or his STM. Both abilities remained normal throughout his life (Corkin, 2002). He was also able to recall details of his past, such as incidents from his school years and from jobs he had held before his surgery; this demonstrates that his LTM was largely intact (Milner et al., 1968). He was also able to form new implicit memories—he was able to learn new skills such as drawing a picture by looking at its reflection in the mirror despite the fact that he had no memory for learning this skill (Milner, 1962). Similar improvements were found for solving puzzles (Cohen et al., 1985). After extensive testing, researchers concluded that H.M.'s amnesia was not due to problems with a particular memory store, but was instead due to problems with one of the control processes associated with those stores. Specifically, H.M. could not transfer declarative memories from STM into LTM.

The fact that H.M.'s brain damage was due to a precise surgical procedure (rather than to widespread damage from an accident like patient K.C.) allowed researchers to pinpoint the area of the brain responsible for this specific memory problem. H.M. was missing the medial temporal lobes of both hemispheres. This damage included the hippocampus and surrounding cortex as well as the amygdala. Based on H.M. and several similar cases, researchers concluded that this region of the brain must be involved with consolidating memories (see Figure 7.13). In fact, the hippocampus was involved in the primacy effect in Deborah Talmi's research, which you read about earlier in this chapter. Thus, there is converging evidence that the hippocampus is engaged in consolidating information in STM so that it may enter and remain in LTM, a process that most of us take for granted.

Figure 7.13 Damage to the Hippocampus: Disruption of Consolidation



When the hippocampus is damaged, the injury interferes with consolidation, the formation of long-term memories. Such damage does not prevent recall of preexisting memories, however.

Stored Memories and the Brain

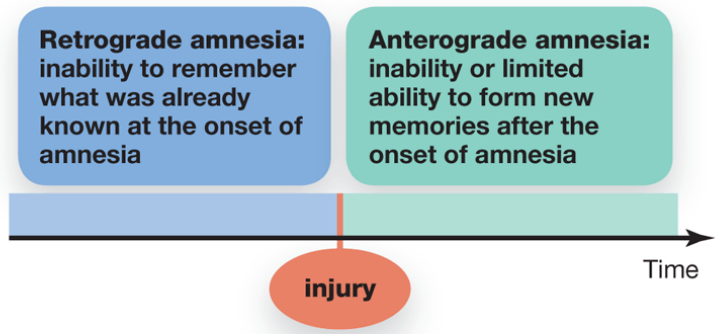
Listen to the Audio

It is important to note that our long-term memories do not just sit on a neurological shelf and collect dust after they have formed. Memory **storage** *refers to the time and manner in which information is retained between encoding and retrieval*. In other words, memory storage is an active process; stored memories can be updated regularly, such as when someone reminds you of an event from years ago, or when you are reminded of information you learned as a child. In this way, memories undergo a process called **reconsolidation**, *in which the hippocampus functions to update, strengthen, or modify existing long-term memories* (Lee, 2010; Söderlund et al., 2012). These memories then form networks in different regions of the cortex, where they can (sometimes) be retrieved when necessary. *These long-term declarative memories are distributed throughout the cortex of the brain, rather than being localized in one region*—a phenomenon known as **cross-cortical storage** (Paller, 2004). Interestingly, with enough use, some of the memory networks will no longer need input from the hippocampus. The cortical networks themselves will become self-sustaining. The more that memory is retrieved, the larger and more distributed that network will become.

Memories that were recently formed and have not had time to develop extensive cross-cortical networks are much more likely to be lost following a head injury than are older memories. Indeed, many people who have experienced a brain injury—including concussions—report that they cannot recall some of the events leading up to their accident. This

type of memory deficit is known as **retrograde amnesia**, *a condition in which memory for the events preceding trauma or injury is lost* (see Figure 7.14). Despite what you might see on soap operas, the "lost time" is generally limited to the seconds or minutes leading up to the injury. The loss of extensive periods of time, as seen in K.C., is quite rare.

Figure 7.14 Retrograde and Anterograde Amnesia



The term *amnesia* can apply to memory problems in both directions. It can wipe out old memories, and it can prevent consolidation of new memories.

The fact that memories can be lost after even minor brain damage shows us that our memory systems are quite delicate. Each of the boxes and arrows in the Atkinson-Shiffrin model (Figure 7.1) can be disrupted in some way; but the formation and storage of long-term memories seems to be particularly sensitive to injuries. K.C.'s devastating injury shows us that when we lose our memories, we lose an important part of ourselves. So be careful.

Module 7.1 Summary

Listen to the Audio

7.1a Know . . . the key terminology of memory systems:

Review Module 7.1

Start Over Swap

0/37 REVIEWED · 0 MASTERED

amnesia

Previous Next Got It!

7.1b Understand . . . which structures of the brain are associated with specific memory tasks and how the brain changes as new memories form.

The hippocampus is critical to the formation of new declarative memories. Long-term potentiation at the level of individual synapses

between nerve cells is the basic mechanism underlying this process. Long-term memory stores are distributed across the cortex. Working memory likely utilizes the parts of the brain associated with visual and auditory perception, as well as the frontal lobes (for functioning of the central executive).

7.1c Apply . . . your knowledge of the neural basis of memory to predict what types of memory would be affected by damage to different areas of the brain.

Apply Activity

Please match the scenarios to the corresponding terms.

Scenario	Term
A car accident has left Harinder with damage to his left temporal lobe. As a result, he now has difficulty recalling facts about objects such as, “Sand is found on a beach.”	Semantic memory
James had a stroke that damaged the temporal lobes, including the hippocampus, on both sides of his brain.	Episodic memory
Minka suffered damage to her basal ganglia and the motor (movement) regions of her frontal lobes. As a result, she cannot remember how to tie her shoes or hold a pencil, although she can understand the functions served by both objects.	Procedural memory

Check Your Understanding

7.1d Analyze . . . the claim that humans have multiple memory systems.

Consider all the evidence from biological and behavioural research, not to mention the evidence from amnesia. Data related to the serial position effect indicate that information at the beginning and end of a list is remembered differently, and even processed and stored differently in the

brain. Also, evidence from amnesia studies suggests that LTM and STM can be affected separately by brain damage or disease. Most psychologists agree that these investigations provide evidence supporting the existence of multiple storage systems and control processes.

Module 7.2 Encoding and Retrieving Memories

Listen to the Audio

Tkreykes/Fotolia

Learning Objectives

7.2a Know . . . the key terminology related to forgetting, encoding, and retrieval.

7.2b Understand . . . how the type of cognitive processing employed can affect the chances of remembering what you encounter.

7.2c Apply . . . what you have learned to improve your ability to memorize information.

7.2d Analyze . . . whether emotional memories are more accurate than non-emotional ones.

According to legend, the first person to develop methods of improving memory was the Greek poet Simonides of Ceos (556–468 BCE). After Simonides presented one of his lyric poems at a dinner party in northern Greece, the host, Scopas, told him that he was only going to pay half of the cost of the poem (he clearly wasn't impressed by the work). Soon after this exchange, a grumpy Simonides was told that two men on horses wanted to talk to him outside. While talking to the horsemen, the roof of Scopas' house collapsed, killing everyone inside (Greek legends are not happy places . . .). When relatives wanted to bury the family, they were unable to figure out who the remains belonged to; no one could recall where the family members had been sitting. Simonides had encoded the information differently than the rest of the guests; he was able to assist the family by creating a visual image of the dinner party and listing who was sitting in each chair. His story demonstrates one of the key points to be discussed in this module—how you encode information affects the likelihood of you remembering that information later.

Why are some memories easier to recall than others? Why do we forget things? How can you use memory research to improve your performance at school and at work? These questions are addressed in this module, where we focus on factors that influence the encoding and retrieval of memories.

Encoding and Retrieval

Listen to the Audio

In its simplest form, memory consists of encoding new information, storing that information, and then retrieving that stored information at a later time. As discussed in Module 7.1, *encoding* is the process of transforming sensory and perceptual information into memory traces, and *retrieval* is the process of accessing memorized information in order to make use of it in the present moment. In between these two processes is the concept of *storage*, the time and manner in which information is retained between encoding and retrieval. Over the past 50 years, researchers have uncovered a number of factors that influence how our memory systems work, and also how we can improve our chances of remembering information. The most important of these factors appears to be how the information was encoded in the first place.

Rehearsal: The Basics of Encoding

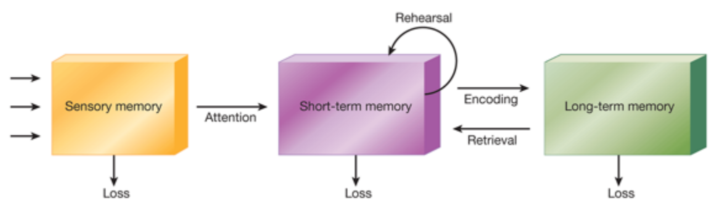
Listen to the Audio

What would you do if someone gave you the address for a house party but you didn't have a pen or your phone around? How would you keep the address in mind until you had a chance to write it down? If you're like most people, you will recite the address over and over again until you can write it down. This type of memorization is known to psychologists as *rehearsal* (although your teachers may have called it *learning by rote*), and it is something probably all of us have tried. Indeed, students often try to learn vocabulary terms by reading flashcards with key terms and definitions over and over. But is this strategy effective?

Certainly this approach works some of the time, but is it really the *most* effective way to remember? Unfortunately for all the cue-card-memorizing students out there, the answer is a resounding "no" (Craik & Watkins, 1973). The limitations of this form of rehearsal were shown in a sneaky experiment performed in the 1970s (see Figure 7.15); in this study, participants were asked to remember a four-digit number. After seeing the number, they were asked to repeat a single word until being prompted to report the number. The delay between the presentation of the number and the participants' responses varied from 2 to 18 seconds; this meant that the amount of time each word was repeated also varied. Because participants were trying to remember the digits, they barely paid attention to the word they repeated. Later, when the researchers surprised the participants by asking them to recall the distracting word they had repeated, they found virtually no relationship between the

duration of rehearsal (between 2 and 18 seconds) and the proportion of individuals who could recall the word (Glenberg et al., 1977). In other words, longer rehearsal did not lead to better recall. This is not to say that repeating the word had no effect at all; rather, this study demonstrated that repeating information only had a small benefit, and that this benefit was not increased with longer rehearsal times.

Figure 7.15 The Limits of Maintenance Rehearsal



This module introduced the concept of rehearsal in the Atkinson-Shiffrin model of memory, as shown above. Notice that rehearsal is distinct from encoding. It keeps information in short term memory, but by itself does not encode information for long-term memory. As you will see, research suggests that encoding is a distinct process based on how much meaning is drawn from the information.

1 of 7 Previous Next

It turns out that it is not *how long* we rehearse information, but rather *how* we rehearse it that determines the effectiveness of memory. Individuals in the study just described were engaged in **maintenance rehearsal**—*prolonging exposure to information by repeating it*—which does relatively little to help the formation of long-term memories (although it is better than nothing). By comparison, **elaborative rehearsal**—*prolonging exposure to information by thinking about its meaning*—significantly

improves the process of encoding (Craik & Tulving, 1975). For example, repeating the word *bottle*, and then imagining what a bottle looks like and how it is used, is an elaborative technique. In the story that began this module, Simonides used a form of elaborative rehearsal by not only memorizing a list of people at a table (Scopus, Constantine, Helena, etc.), but actively imagining the dinner table and thinking about where people were relative to each other.

Although maintenance rehearsal helps us remember for a very short time, elaborative rehearsal improves long-term learning and remembering. It is worth paying attention to this research and thinking about how it applies to your success as a student (a form of elaborative rehearsal of this information). Obviously, being a student involves encoding a large amount of information into your memory in a relatively small amount of time. Imagine how the two types of rehearsal may come into play in meeting the challenge of university-level learning. Students who simply memorize key terms and repeat the definitions largely fail to employ elaborative rehearsal, and are less likely to do well on an exam. The wise strategy is to try to elaborate on the material.

Levels of Processing

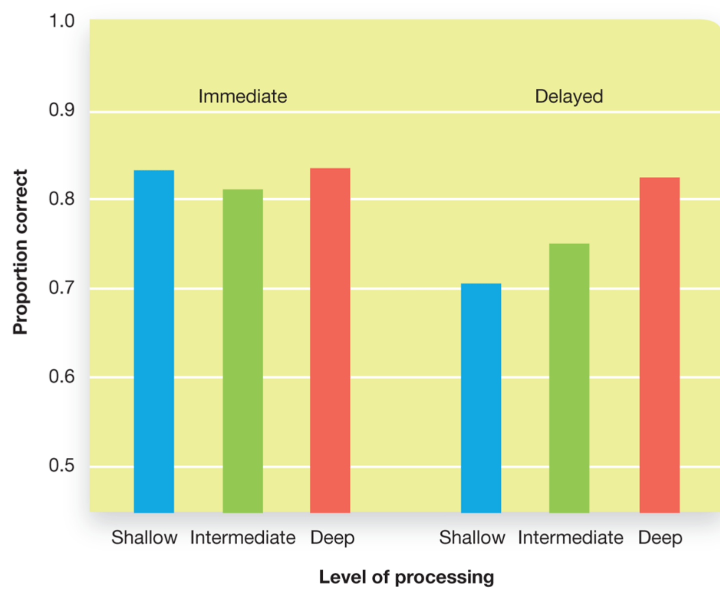
Listen to the Audio

Although we often find ourselves using maintenance rehearsal in a pinch, we rarely use that strategy for information that we intend to remember much later. Instead, we focus on elaborative encoding, where additional sensory or semantic (meaning) information is associated with the to-be-remembered item. But not all elaborative encoding is created equal. Instead, different types of elaborative encoding can produce markedly different levels of recall. The details surrounding this variability were first described by researchers at the University of Toronto, and led to a framework for memory known as *levels of processing* (LOP).

The LOP framework begins with the understanding that our ability to recall information is most directly related to how that information was initially processed (Craik & Lockhart, 1972). Differences in processing can be described as a continuum ranging from shallow to deep processing. **Shallow processing**, as you might guess, *involves encoding more superficial properties of a stimulus, such as the sound or spelling of a word*. **Deep processing**, *on the other hand, is generally related to encoding information about an item's meaning or its function*. The superiority of deep processing was demonstrated in a study in which participants encoded words using shallow processing (e.g., "Does this word rhyme with *dust?. . . TRUST*") or deep processing (e.g., "Is this word a synonym for *locomotive?. . .TRAIN*"). When given a surprise memory test for the words, the differences ranged from recalling as few as 14% of the shallow words to 96% of the deeply processed words (Craik & Tulving, 1975). In

essence, they were almost seven times more likely to recall a deeply processed word than one that was processed at only a shallow level. Importantly, such effects are limited to LTM; STM memory rates are unaffected by shallow or deep processing (Rose et al., 2010; Figure 7.16).

Figure 7.16 Levels of Processing Affect Long-Term Memory, But Not Working Memory



When tested immediately after studying words, levels of processing do not seem to affect memory. In contrast, when there is a gap between studying words and being tested, levels of processing are important. When words are encoded based on their meaning (semantics), they are better retained in long-term memory.

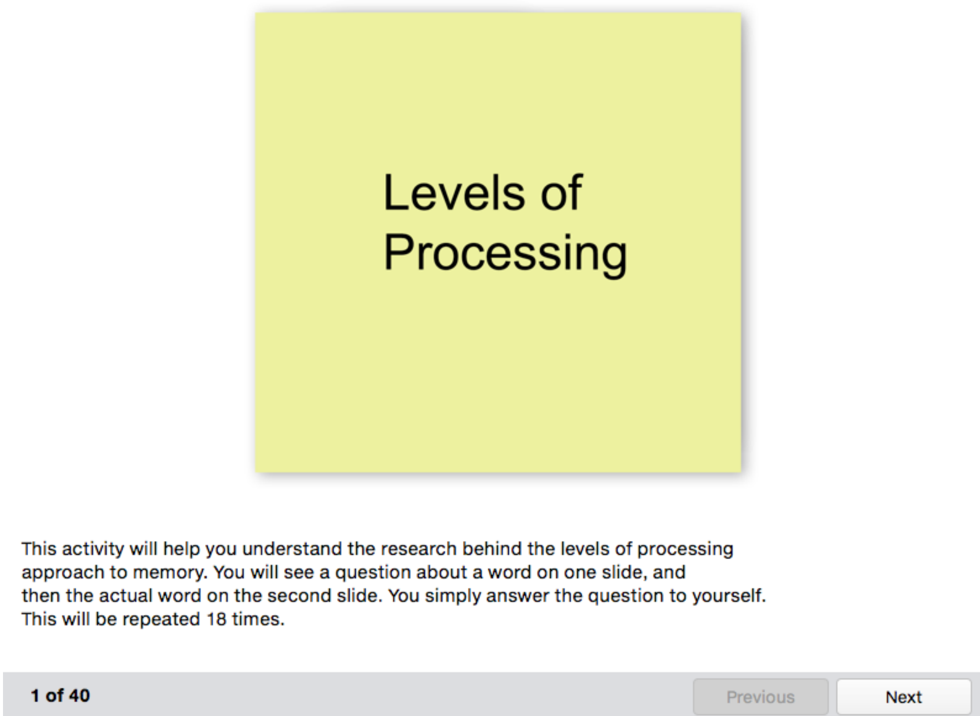
Source: Rose, N., Myerson, J., Roediger, H., & Hale, S. (2010). Similarities and differences between working memory and longterm memory: Evidence from the levels-of-processing span task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*(2), 471–483.

Similar effects have been found for another form of deep processing. The **self-reference effect** *occurs when you think about information in terms of how it relates to you or how it is useful to you; this type of encoding will lead to you remembering that information better than you otherwise would have* (Symons & Johnson, 1997). This outcome is not terribly surprising, but it

is still helpful to think about when learning new material. The self-reference effect is one of the reasons why your psychology professor (and this text) tries to show you how psychological concepts relate to your life—linking a concept to "you" will help you remember it later.

Although encoding strategies clearly influence our ability to remember information later, they only tell part of the story. The conditions in which we attempt to retrieve information from memory can also affect whether or not that information will be recalled.

Experimenting with Levels of Processing



Retrieval

Listen to the Audio

Once information is encoded—be it in a deep or shallow fashion—and stored in memory, the challenge is then to be able to retrieve that information when it is needed. There are two forms of intentional memory retrieval, both of which are familiar to long-suffering students like the readers of this text. **Recognition** *involves identifying a stimulus or piece of information when it is presented to you*. Examples of recognition memory would be identifying someone you know on the bus (or in a police lineup), or answering standard multiple-choice test questions. **Recall** *involves retrieving information when asked, but without that information being present during the retrieval process*. Examples of this would be describing a friend's appearance to someone else or answering short-answer or essay questions on an exam.

Recall is helped substantially when there are hints, or *retrieval cues*, that help prompt our memory. The more detailed the retrieval cue, the easier it is for us to produce the memory. For instance, if you were given a list of 30 words to remember, it is unlikely that you would be able to recall all of the words. But if you were given a hint for a "forgotten" word, such as "gr—" for the word *grape*, you would be likely to retrieve that information. The hint *grap-* would provide even more information than "gr—" and would lead to even better retrieval (Tulving & Watkins, 1975). However, life is not a series of word lists. Instead, retrieval cues in the real world often involve places, people, sights, and sounds—in other words, the environment or context in which you are trying to retrieve a memory.

Researchers have found that *retrieval is most effective when the conditions at the time of encoding and retrieval are the same*, a tendency known as the **encoding specificity principle** (Tulving & Thompson, 1973).

The encoding specificity principle can take many forms. It can include internal contexts such as mood and even whether a person is intoxicated or not. As you'll see in the next section, encoding specificity can also include external contexts such as the physical setting.

Working the Scientific Literacy Model

Context-Dependent Memory

Listen to the Audio

One of the most intuitive forms of encoding specificity is **context-dependent memory**, *the idea that retrieval is more effective when it takes place in the same physical setting (context) as encoding*. But what elements of the environment make up "context"? Is one sense (e.g., smell) enough to produce this effect? And does context specificity affect all types of memory equally?

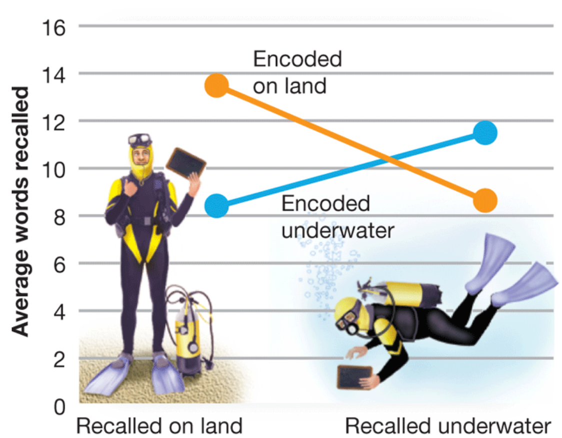
What do we know about context-dependent memory?

The initial demonstrations of context-dependent learning and memory used very simple cues: words. In such studies, participants learned pairs of words; some of the words might be associated with each other (e.g., *bark – dog*) and others might rhyme with each other (e.g., *worse – nurse*). A recall test for the second words in each pair (e.g., *dog* or *nurse*) generally led to respectable memory performance. However, performance improved when the original context (the first word of the word pair) was reinstated and could serve as a retrieval cue; the more information from the original context that was included, the better the level of retrieval (Tulving & Watkins, 1975).

Subsequent studies have focused on the role of environmental contexts on memory. In a classic study, members of a scuba club

volunteered to memorize word lists—half of the test participants did so while diving 6.7 m (20 feet) underwater, and half did so while on land (Godden & Baddeley, 1975). After a short delay, the divers were tested again; however, some of the experimental participants had switched locations. This led to four test groups: trained and tested underwater, trained and tested on dry land, trained underwater but tested on land, and trained on land but tested underwater. As you can see in Figure 7.17, the results demonstrated that context affects memory. Those who were tested in the same context as where encoding took place (i.e., land–land or underwater–underwater) remembered approximately 40% more items than those who switched locations (i.e., land–underwater or underwater–land). Thus, both controlled laboratory studies and studies involving dramatic environmental manipulations have shown that matching the encoding and retrieval contexts leads to better recall of studied material.

Figure 7.17 Context-Dependent Learning



Divers who encoded information on land had better recall on land than underwater. Divers who encoded information underwater had the reverse experience, demonstrating better recall underwater than when on land.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed., © 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

How can science explain context-dependent memory?

Context-dependent memory clearly demonstrates that the characteristics of the environment can serve as retrieval cues for memory. In the Godden and Baddeley (1975) study, the primary cue was likely the feeling of being underwater; however, diving also involves a change of lighting as well as the sounds of the breathing apparatus. In other words, when we encode information, we are also encoding information from a number of senses (vision, hearing, touch, etc.). Presumably, each of these senses can help trigger memories. For instance, most of you have had the experience in which an odour (e.g., fresh-baked cookies) instantly brings back memories (e.g., your grandmother's kitchen). This common phenomenon was tested in a clever experiment by researchers in the U.K. In this study, researchers tested whether memory of the Viking museum in York could be enhanced if the memory test occurred in a room with a similar distinctive set of smells as the museum (burned wood, apples, garbage, beef, fish, rope/tar, and earth . . . perhaps the Viking equivalent of Axe body spray). The researchers found that participants produced more accurate memories of the museum when the smell of the test room matched the smell of the museum (Aggleton & Waskett, 1999). Similar results have been found for the effect of smells on memory for word lists (Stafford et al., 2009). Context-dependent memory has also been found for the flavour of gum being chewed during encoding and retrieval (Baker et al., 2004) as well as for the amount of background noise when students are studying and taking a test (Grant et al., 1998). These results suggest that matching the physical and sensory

characteristics of the encoding and retrieval environments affect memory, likely due to the retrieval cues provided by these attributes.

Brain imaging studies have also provided evidence in favour of context-dependent memory. Studies using fMRI have found increased activity in the hippocampus and parts of the prefrontal cortex (part of the frontal lobes) when the retrieval conditions match the context in which the memory was encoded (Kalisch et al., 2006; Wagner et al., 1998). Activity in the right frontal lobes is particularly sensitive to context, likely because this region is known to be critical for the retrieval process (Tulving et al., 1994).

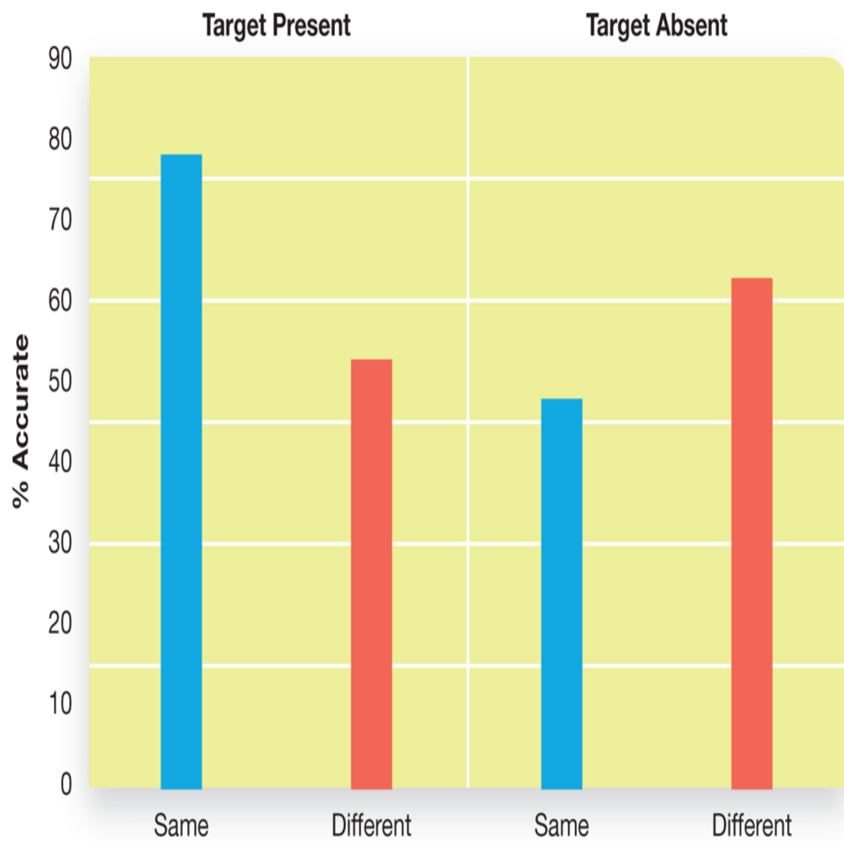
Can we critically evaluate this evidence?

Although there is evidence that context-dependent memory exists, there are some important limitations to these effects. First, not all types of memory are equally enhanced by returning a person to the context in which he or she encoded the to-be-remembered information. Recognition memory (e.g., multiple-choice questions) is not significantly helped by context; this is likely due to the fact that the presence of the item (e.g., a photograph or one of the options on a test question) already serves as a very strong retrieval cue (Fernández & Alonso, 2001). Recall, on the other hand, requires you to generate the to-be-remembered information without any external cues. In this case, returning to the encoding context could help prompt a memory. Second, information that is central to a memory episode (e.g., a person's face in a photograph or in a conversation) is generally unaffected by context. Peripheral information (e.g., the faces of people who were nearby when you were having a conversation) does seem to be enhanced when a person returns to the original context (Brown, 2003; Sutherland & Hayne, 2001). As a rule,

when memory for information is quite good, context will have little effect on accuracy; however, when memory is relatively poor, then returning to the encoding context can improve recall.

There is one additional issue related to context- dependent memory. Researchers at Simon Fraser University have noted that returning a person to the context in which he encoded information can improve recall *and* increase the number of false positives (i.e., saying "I remember" to stimuli that were never seen). Wong and Read (2011) showed participants a video of a staged crime; viewing took place in either a large testing room or a small study room. Participants returned one week later for a follow-up test in which they were asked to identify the culprit from a photo lineup. This test took place either in the same room as the initial viewing of the video or in the opposite room. The catch was that for half of the participants, the photo lineup did not include the person from the original video (the "target absent condition"). The results of the test demonstrated the effect of context: Performance was much higher when the testing took place in the same room as the initial encoding. However, participants who took the test in the same context as they saw the video were also more likely to claim that a photo looked familiar *even in the target-absent condition* (see Figure 7.18). Returning to the encoding context may therefore alter a person's threshold for saying "I remember." This trend is likely due to the retrieval cues associated with the environment leading to a feeling of familiarity that is mistakenly attributed to the to-be-remembered information (Leboe & Whittlesea, 2002), in this case the face of a criminal. This study has clear implications for police procedures, as many police departments encourage returning witnesses to the scene of a crime in order to improve their memories (Hershkowitz et al., 1998; Kebbell et al., 1999).

Figure 7.18 False Familiarity and Context-Dependent Memory



In a study involving the identification of a thief in a staged robbery, participants viewed a robbery and then later selected the thief from a lineup of photographs. If both stages of the study were performed in the same room (i.e., the context had been reinstated), identification of the thief increased. However, we should also keep in mind that participants were also more likely to rate an incorrect face as being familiar; this is shown by the *lower* accuracy score for the Same than for the Different contexts in the Target Absent condition on the right.

Source: From Wong, C. K., & Read, J. D. (2009). Positive and negative effects of physical context reinstatement on eyewitness recall and identification. *Applied Cognitive Psychology*, *25*, 2–11. Figure 2 (p. 7). Copyright © 2009 by John Wiley & Sons, Inc. Reproduced by permission of John Wiley & Sons, Inc.

Why is this relevant?

One of the most interesting implications of context-dependent memory research is that it implies that some forgotten

information is not gone forever, but is instead simply inaccessible because the proper cues have not been provided (Tulving, 1974). This is the assumption made by police investigators who return witnesses to the scene of the crime. However, the results of the Wong and Read (2011) photo lineup story do suggest that we need to be cautious in our interpretation of context-dependent memory, as the retrieval cues associated with the context could actually lead to false feelings of familiarity that could have devastating effects on people's lives.

State-Dependent Memory

Listen to the Audio

Although we are sure that most readers of this book dedicate their lives to healthy eating and exercise, it is likely that a few of you will have consumed substances that can affect your memory. For example, people sometimes drink enough alcohol that they are unable to remember some details of their night out with their friends. But is that information gone forever or can it be accessed in the same way that some context-dependent memories can be retrieved with the help of environmental cues? Research suggests that *retrieval is more effective when your internal state matches the state you were in during encoding*, a phenomenon known as **state-dependent memory**. In the first demonstration of this, Goodwin and colleagues (1969) got half of their participants extremely drunk (their blood-alcohol level was three times the legal limit); the other half were sober. Participants encoded information and completed several memory tests; they were then instructed to return 24 hours later for additional testing (and a new liver). On Day 2 of testing, half of the participants were again put into a state of severe intoxication; half of these participants had also been drunk on Day 1, and the other half had been sober. Thus, there were four groups: drunk–drunk (drunk on Day 1 and Day 2), drunk–sober, sober–drunk, and sober–sober. Not surprisingly, the sober–sober group outperformed all of the others. However, tests of recall showed that the drunk–drunk group outperformed the groups in which participants were intoxicated during only one of the two test sessions. The state of intoxication served as a retrieval cue for the participants' memory. As with context-dependent memory, this effect

appears to be strongest for declarative memory (e.g., recall), the form of memory that requires the participant to generate the response on their own (Duka et al., 2001).

Similar effects have been found for other substances, including marijuana (Hill et al., 1973; Stillman et al., 1974) and caffeine (Kelemen & Creeley, 2003). However, it is important to remember that, like context-dependent memory, the effects of state-dependent memory are fairly small. Additionally, almost all studies find that the participants who were sober during both encoding and retrieval outperformed the other groups. To be clear, drinking to excess is not an effective study strategy.

Mood-Dependent Memory

Listen to the Audio

Just as similar contexts and chemical states can improve memory, studies of **mood-dependent memory** indicate that *people remember better if their mood at retrieval matches their mood during encoding* (Bower, 1981; Eich & Metcalfe, 1989). Volunteers in one study generated words while in a pleasant or unpleasant mood, and then attempted to remember them in either the same or a different mood. The results indicated that if the type of mood at encoding and retrieval matched, then memory was superior. However, changes in the intensity of the mood did not seem to have an effect (Balch et al., 1999).

As with context- and state-dependent memory, mood-dependent memory has some limitations (Eich et al., 1994). Mood has a very small effect on recognition memory; it has much larger effects on recall-based tests. Additionally, it produces larger effects when the participant must generate both the to-be-remembered information (e.g., "an example of a musical instrument is a g____") than if the stimuli are externally generated (e.g., "remember this word: *guitar*"). In the first example, the participant must put more of his own cognition into the encoding process. Those cognitive processes become important retrieval cues during a later recall-based test.

Although its effects are limited, mood-dependent memory does show that a person's emotional state can have an effect on encoding and retrieval.

As we shall see, the influence of emotion can be even more dramatic when the stimuli themselves are emotional in nature.

Varieties of Encoding Specificity

The encoding specificity principle predicts that retrieval is most effective when it occurs in the same context as encoding, but what exactly makes up a context? Select each tab below. There are several ways to define it.

Context-Dependent Learning

State-Dependent Learning

Mood-Dependent Learning

Context-Dependent Forgetting

Context-Reinstatement Effect

Emotional Memories

Listen to the Audio

When you think back to different times in your life, the events that first come to mind are often emotional in nature, such as a wonderful birthday party or the fear of starting at a new school. Emotion seems to act as a highlighter for memories, making them easier to retrieve than neutral memories. This is because emotional stimuli and events are generally self-relevant and are associated with arousal responses such as increased heart rate and sweating. In linking emotion and memory back to topics discussed earlier in this module, it seems reasonable to assume that emotion leads to deep processing of information.

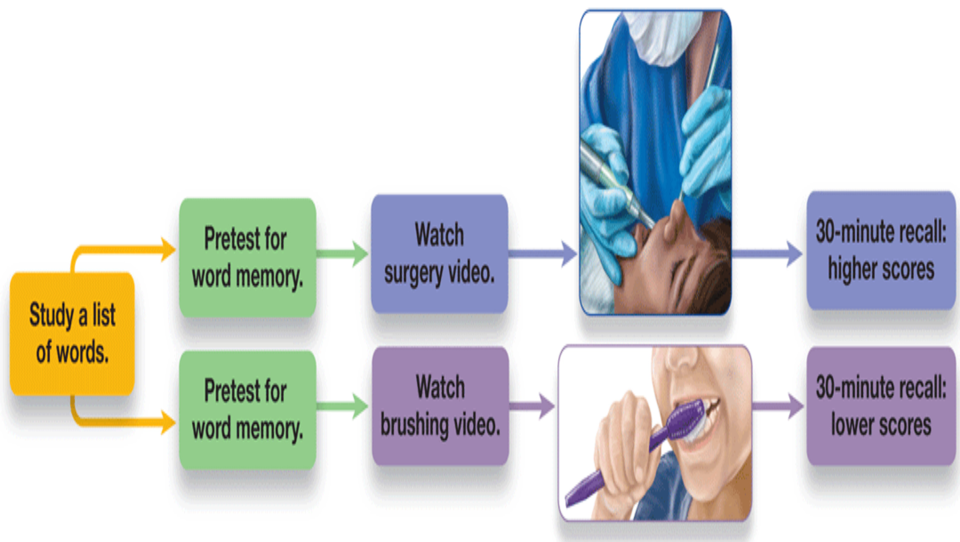
The tendency for emotion to enhance our memory for events has been demonstrated in a number of studies (LaBar & Cabeza, 2006; Levine & Pizarro, 2004). For instance, in one experiment, undergraduate students viewed a series of images that were emotionally negative (e.g., a snarling dog), emotionally positive (e.g., a puppy), or neutral. These participants rated the images in terms of their emotion (positive vs. negative), arousal (high vs. low), and visual complexity. Two weeks later, the participants were given a memory test for the images that they had rated. Recollection was enhanced for negative and, to a lesser extent, positive images (Ochsner, 2000). Similar results have been found with emotional words (e.g., Kensinger & Corkin, 2003) and images depicting someone's daily activities (Laney et al., 2003). It seems that the emotion-related aspects of stimuli do indeed improve memory, particularly for stimuli that trigger negative emotions.

However, although it is intuitive to think that emotion will boost all forms of memory, psychology researchers have found that emotion has fairly specific effects. For example, people often focus their attention on the emotional content of a scene (e.g., a snake). This information—which typically forms the centre of the field of vision—is more likely to be remembered than peripheral information (e.g., the flowers near the snake). This phenomenon can take a more sinister turn in the courtroom. Many eyewitnesses to crimes have shown reductions in memory accuracy due to **weapon focus**—*the tendency to focus on a weapon at the expense of peripheral information, including the identity of the person holding the weapon* (Kramer et al., 1990; Loftus et al., 1987). Indeed, weapon focus provides an example of how specific emotion's effects on memory can be—experiencing emotions such as fear or stress tend to impair a person's ability to encode new information unless that information is itself emotional in nature (Shields et al., 2017). Research has also shown that the memory enhancing effect of emotion is strongest after long (one hour or more) rather than short delays (LaBar & Phelps, 1998; Sharot & Phelps, 2004). This suggests that emotion's largest influence is on the process of *consolidation*, when information that has recently been transferred from short-term memory (STM) into long-term memory (LTM) is strengthened and made somewhat permanent. Emotion has less of an effect on STM and on recognition memory; these types of memory have much less variability than LTM, thus leaving less room for emotion to influence accuracy levels.

Emotion can influence memory consolidation even if the stimuli themselves are not emotional in nature. For example, in one study, participants studied a list of words and were then randomly assigned to view a video of dental surgery (the emotional condition) or the way to brush your teeth effectively (presumably *not* the emotional condition). Afterwards, the group members who viewed the surgery video remembered more of the words (see Figure 7.19) (Nielson et al., 2005).

The researchers suggested that this effect was due to the emotional arousal associated with seeing the dental surgery video. The hormones released when one is experiencing intense emotions influence how numerous brain areas work together to consolidate memories. Thus, the physiological responses associated with emotions can lead to stronger memory formation, even if the to-be-remembered information is not directly related to the emotional event.

Figure 7.19 Does Emotion Improve Memory?

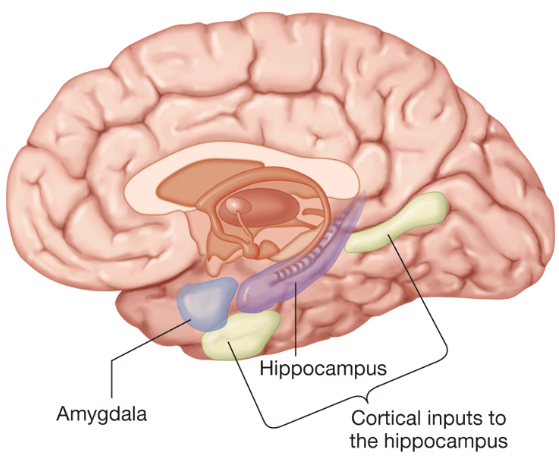


In the study by Nielson and colleagues (2005), both groups remembered approximately the same percentage of words at pretest, and then watched dentistry videos unrelated to the word lists. The group whose members watched the more emotional video recalled more of the words in the end, suggesting that the emotional arousal associated with the video helped consolidate memory for the words.

Researchers have identified many of the brain areas that allow emotion to influence memory (Phelps, 2004). Much of this relationship involves structures in the temporal lobe of the brain: the hippocampus (the structure associated with the encoding of long-term memories) and the amygdala (a structure involved in emotional processing and responding).

Brain imaging shows that emotional memories often activate the amygdala, whereas non-emotional memories generated at the same time do not (Sharot et al., 2007). These studies have shown that the amygdala can also alter the activity of several temporal-lobe areas that send input to the hippocampus (Dolcos et al., 2004). As a result, the cells in these brain regions fire together more than they normally would, which may lead to more vivid memories (Kilpatrick & Cahill, 2003; Paz & Paré, 2013; see Figure 7.20). However, this coordinated neural activity still does not guarantee that all of the details of an experience will be remembered with complete accuracy.

Figure 7.20 Emotion, Memory, and the Brain



Activity in the amygdala influences the activity of nearby regions in the temporal lobes, increasing the degree to which they fire together. This alters the type of input received by the hippocampus from regions of the cortex (the outer part of the temporal lobes).

Flashbulb Memories

Listen to the Audio

Can you remember where you were when Sidney Crosby scored the "golden goal" to win the gold medal in the 2010 Olympics hockey final? For non-hockey fans, that afternoon might simply have been a fun time with friends and family, or perhaps was entirely forgettable if they weren't watching the game. But for others, the memory of that event might take on a vivid, almost photographic, quality that feels like it will remain perfectly etched in memory forever. Researchers have labelled this type of intense and unique memory as being a **flashbulb memory**—*an extremely vivid and detailed memory about an event and the conditions surrounding how one learned about the event* (Brown & Kulik, 1977). (The term *flashbulb* refers to the flash of an old-fashioned camera.) These highly charged emotional memories typically involve recollections of location, what was happening around oneself at the time of the event, and the emotional reactions of self and others (Brown & Kulik, 1977). Some may be personal memories, such as the memory of an automobile accident. Other events are so widely felt that they seem to form flashbulb memories for an entire society, such as the assassination of U.S. President Kennedy in 1963 (Brown & Kulik, 1977), the explosion of the space shuttles *Challenger* or *Columbia* (Kershaw et al., 2009; Neisser & Harsch, 1992), and the terrorist attacks of September 11, 2001 (Hirst et al., 2009; Paradis et al., 2004). One defining feature of flashbulb memories is that people are highly confident that their recollections are accurate. But is this confidence warranted? Several studies (described in the Myths in

Mind section that follows) suggest that we should give flashbulb memories a second look.

Myths in Mind

The Accuracy of Flashbulb Memories

Although flashbulb memories are very detailed and individuals reciting the details are very confident of their accuracy, it might surprise you to learn that they are not necessarily more accurate than many other memories (Hirst & Phelps, 2016). For example, researchers examined how university students remembered the September 11, 2001, attacks in comparison to an emotional but more mundane event (Talarico & Rubin, 2003). On September 12, 2001, they asked students to describe the events surrounding the moment they heard about the attacks. For a comparison event, they asked students to describe something memorable from the preceding weekend, just two or three days before the attacks. Over several months, the students were asked to recall details of both events, and the researchers compared the accuracy of the two memories. Although their memory for both events was fading at the same rate and they were equal in accuracy, the students acknowledged the decline in memory only for the mundane events. They continued to feel highly confident in their memories surrounding the September 11 attacks, when, in fact, those memories were not any more accurate. The same pattern has been found for other major flashbulb events, such as the end of World War II in Europe (Berntsen & Thomsen, 2005) and the 1986 space shuttle *Challenger* explosion (Neisser & Harsch, 1992).

Watch **Thinking Like a Psychologist** Police Lineup

Forgetting and Remembering

Listen to the Audio

Have you ever had the experience of studying intensely for an exam, writing it, and then forgetting almost everything as soon as you walked out of the exam room? This phenomenon is quite common, particularly if you did all of your studying the night before (or morning of) the exam. Forgetting information is probably a good thing, at least if it occurs in moderation. We don't need to remember every detail about every day of our lives. Instead, we want to have some control over what we do remember, thus allowing us to keep the useful information (e.g., terms for an exam) and deleting the less useful information (e.g., the details of a conversation you overheard on the bus). Of course, if we had that type of control, there would be no need to study the intricacies of why we remember and forget things. As you will see, this issue has been researched extensively.

The Forgetting Curve: How Soon We Forget . . .

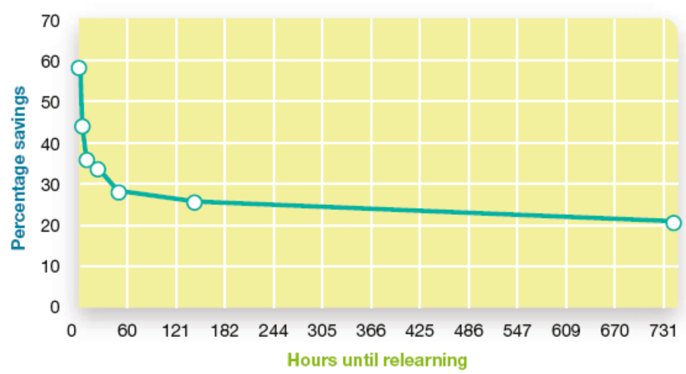
Listen to the Audio

It might seem odd that the first research on remembering was actually a documentation of how quickly people forget. However, this approach does make sense: Without knowledge of forgetting, it is difficult to ascertain how well we can remember. This early work was conducted by Hermann Ebbinghaus, whom many psychologists consider the founder of memory research. Ebbinghaus (1885) was his own research participant in his studies; these experiments involved him studying hundreds of nonsense syllables for later memory tests. His rationale was that because none of the syllables had any meaning, none of them should have been easier to remember based on past experiences. Ebbinghaus studied lists of these syllables until he could repeat them twice. He then tested himself repeatedly—this is where his persistence really shows—day after day.

How soon do we forget? The data indicated that Ebbinghaus forgot about half of a list within an hour. If Ebbinghaus had continued to forget at that rate, the rest of the list should be lost after two hours, but that was not the case. After a day, he could generally remember one-third of the material, and he could still recall between 20% and 25% of the words after a week. The graph in Figure 7.21 shows the basic pattern in his test results, which has come to be known as a *forgetting curve*. The **forgetting curve** *shows that most forgetting occurs right away, and that the rate of forgetting eventually slows to the point where one does not seem to forget at all*. These results have stood the test of time. In addition to being replicated

as a lengthy case study (Murre & Dros, 2015), more than 200 articles have been published in psychological journals that fit Ebbinghaus's forgetting curve (Rubin & Wenzel, 1996). In fact, one study demonstrated that this forgetting curve applies to information learned over 50 years before (see Figure 7.22; Bahrick, 1984).

Figure 7.21 Ebbinghaus's Forgetting Curve



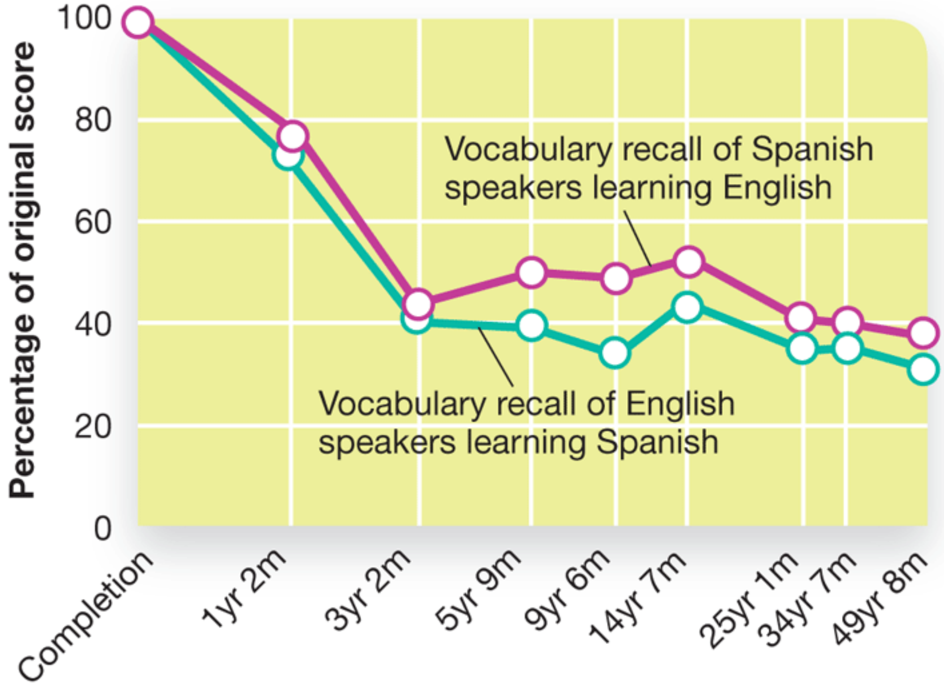
The Original Forgetting Curve

This graph reveals Ebbinghaus's results showing the rate at which he forgot a series of nonsense syllables. You can see that there is a steep decline in performance within the first day and that the rate of forgetting levels off over time.

1 of 4 Previous Next

Source: Memory: A Contribution to Experimental Psychology, Hermann Ebbinghaus (1885). Translated by Henry A. Ruger & Clara E. Bussenius (1913). Originally published in New York by Teachers College, Columbia University.

Figure 7.22 Bahrick's Long-Term Forgetting Curve



This forgetting curve depicts the rate at which adults forgot the foreign language they took in high school. Compared to new graduates, those tested three years later forgot much of what they learned. After that, however, test scores stabilized, just as Ebbinghaus's did a century earlier.

Source: From Bahrick, H. P. (1984). Semantic memory content in permastore: Fifty years of memory for Spanish learned in school. *Journal of Experimental Psychology: General, 113* (1), 1–29. American Psychological Association.

Given that the forgetting curve has been documented in hundreds of experiments, it seems inevitable that we will forget most of the information that we attempt to encode. However, as you have undoubtedly learned over the course of your studies, there are techniques that will allow you to improve your memory so that the forgetting curve is not as steep.

Mnemonics: Improving Your Memory Skills

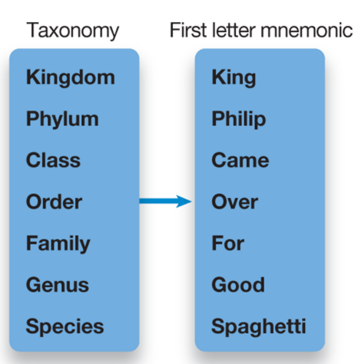
Listen to the Audio

At the beginning of this module, you read about the poet Simonides and his ability to use mental imagery to improve his memory, thus allowing him to identify the remains of people crushed under a collapsed roof. Simonides was using a primitive type of **mnemonic**—*a technique intended to improve memory for specific information*. As you will see in this section, there are a number of different mnemonics that could be used to improve memory, something that might be of interest to overwhelmed students.

The technique that Simonides was using is known as the **method of loci** (pronounced "LOW-sigh"), *a mnemonic that connects words to be remembered to locations along a familiar path*. To use the method of loci, one must first imagine a route that has landmarks or easily identifiable spaces—for example, the things you pass on your way from your home to a friend's house or the seats around a dinner table. Once the path is identified, the learner takes a moment to visually relate the first word on the list to the first location encountered. For example, if you need to remember to pick up noodles, milk, and soap from the store and the first thing you pass on the way to your friend's house is an intersection with a stop sign, you might picture the intersection littered with noodles, and so on down the list. The image doesn't need to be realistic—it just needs to be distinct enough to be memorable. When it is time to recall the items, the learner simply imagines the familiar drive, identifying the items to be purchased as they relate to each location along the path.

However, the method of loci can become a bit cumbersome when a person has to remember hundreds of different facts, as occurs for university exams. A more practical mnemonic is the use of **acronyms**, *pronounceable words whose letters represent the initials of an important phrase or set of items*. For example, the word "scuba" came into being with the invention of the self-contained underwater breathing apparatus. "Roy G. Biv" gives you the colours of the rainbow: red, orange, yellow, green, blue, indigo, and violet. A related mnemonic, the **first-letter technique**, *uses the first letters of a set of items to spell out words that form a sentence*. It is like an acronym, but it tends to be used when the first letters do not spell a pronounceable word (see Figure 7.23). One well-known example is "Every Good Boy Does Fine" for the five lines on the treble clef in musical notation. Another is "My Very Excited Mother Just Showed Us Nine Planets" for the nine planets in the solar system (Pluto is now a "dwarf planet"). These types of mnemonic techniques work by organizing the information into a pattern that is easier to remember than the original information. By using these mnemonics, you can transform a lengthy chapter about memory into a handful of words and sentences. That will definitely make studying easier.

Figure 7.23 The First-Letter Technique



Students of biology often use mnemonics, such as this example of the first-letter technique, which helps students remember the taxonomic system.

The method of loci relies on mental imagery of a familiar location or path, like this path that students take to class three times a week.

Lori Howard/Shutterstock

A number of mnemonic devices are based on the premise of dual coding. **Dual coding** *occurs when information is stored in more than one form*—such as a verbal description and a visual image, or a description and a sound—and it regularly produces stronger memories than the use of one form alone (Clark & Paivio, 1991). Dual coding leads to deeper, as opposed to shallow, processing; this is because the additional sensory representations require some effort to create and produce a larger number of memory associations. This leads to a greater number of potential retrieval cues that can be accessed later. For example, most children growing up in North America learned the alphabet with the help of a song. In fact, even adults find themselves humming portions of that song when alphabetizing documents (you'll probably do it too if asked which letter comes after "k"). Both the visual "A-B-C-D" and the musical "eh-bee-see-dee" are encoded together, making memory easier than if you were simply given visual information to remember. The simplest explanation for the dual-coding advantage is that twice as much information is stored.

The application of mnemonic strategies can be found in restaurants where servers are not allowed to write out orders. These servers use a variety of the techniques discussed in this chapter. Some use chunking strategies, such as remembering soft drinks for a group of three customers, and cocktails for the other four. They also use the method of loci to link faces with positions at the table. In one study, a waiter was able to recall as many as 20 dinner orders (Ericsson & Polson, 1988). He used the method of loci by linking food type (starch, beef, or fish) with a table location, and he used acronyms to help with encoding salad dressing choices. Thus RaVoSe for a party of three would be ranch, vinegar and oil, and sesame. Servers, as well as memory researchers, will tell you that the worst thing restaurant patrons can do is switch seats, as it completely disrupts the mnemonic devices being used to remember the order (Bekinschtein et al., 2008).

While these mnemonic devices can help with rote memorization, they may not necessarily improve your understanding of material. Researchers have begun to examine other memory boosters that may offer more benefits for understanding and retaining information. For example, some research has shown the advantages of **desirable difficulties**–*techniques that make studying slower and more effortful, but result in better overall remembering*. For instance, in Module 1.1 you read about the benefits of spreading out study sessions rather than cramming for an exam in one long session (spaced vs. massed learning). When you space out your sessions, it is likely that you will forget some of the items from the previous study session (Smolen et al., 2016). As a result, you'll reread those notes and study them in more depth, a behaviour that will improve your chances of remembering the information later. Studying material in varying orders has a similar effect.

Another popular approach to studying is to use flashcards. Although psychologists have begun to understand how this process benefits

students, they also have identified a few mistakes students frequently make when using flashcards. The first thing to remember is the spacing effect. When studying with flashcards, it is better to use one big stack rather than several smaller stacks; using the entire deck helps take advantage of the effect of spacing the cards. A second potential problem is the fact that students become overconfident and drop flashcards as soon as they believe they have learned the material. In reality, doing so seems to reduce the benefits of overlearning the material (making it more difficult to forget) and spacing out cards in the deck (Kornell, 2009; Kornell & Bjork, 2007). No matter how you study, you should take advantage of the **testing effect**, *the finding that taking practice tests can improve exam performance, even without additional studying*. In fact, researchers have directly compared testing to additional studying and have found that, in some cases, testing actually improves memory more (Roediger et al., 2010). That's why psychology texts such as this one include quizzes and online tests.

Module 7.2 Summary

Listen to the Audio

7.2a Know . . . the key terminology related to forgetting, encoding, and retrieval.

Review Module 7.2

Start Over Swap

0/21 REVIEWED · 0 MASTERED

mnemonic

Previous Next Got It!

7.2b Understand . . . how the type of cognitive processing employed can affect the chances of remembering what you encounter.

Generally speaking, deeper processing makes things more likely to be remembered. Greater depth of processing may be achieved by elaborating on the meaning of the information, through increased emotional content, and through coding in images and sounds simultaneously.

7.2c Apply . . . what you have learned to improve your ability to memorize information.

Rather than simply memorizing the different types of mnemonics, try the following activity to see examples of these techniques in action. Doing so will allow you to more deeply encode this information.

Apply Activity What You Have Learned to Improve Your Ability to Memorize Information

Match the following scenarios to the mnemonic technique they are depicting. Select "Check Your Understanding" when you're ready.

Scenario	Technique
Meenu remembers the names of the Great Lakes by thinking of the word HOMES.	Use of Acronyms
Danielle takes practice tests that she found online to help her study for her biology exam.	Testing Effect
Malcolm remembers the order of the colours of the rainbow by reciting, "Richard of York Gave Battle in Vain."	First-Letter Technique
Judith memorized the date Christopher Columbus landed in the Americas by singing a song about Columbus sailing the ocean blue in 1492.	Dual Coding
Sharlynn remembers the different organs of the body by thinking about walking through the different areas of the hospital her Dad works at.	Method of Loci

Check Your Understanding

7.2d Analyze . . . whether emotional memories are more accurate than non-emotional ones.

Both personal experiences and controlled laboratory studies demonstrate that emotion enhances memory. However, as we learned in the case of flashbulb memories, even memories for details of significant events decline over time, although confidence in memory accuracy typically remains very high.

Module 7.3 Constructing and Reconstructing Memories

Listen to the Audio

RiceWithSugar/Shutterstock.com

Learning Objectives

7.3a Know . . . the key terminology used in discussing how memories are organized and constructed.

7.3b Understand . . . how schemas serve as frameworks for encoding and constructing memories.

7.3c Understand . . . how psychologists can produce false memories in the laboratory.

7.3d Apply . . . what you have learned to judge the reliability of eyewitness testimony.

7.3e Analyze . . . the arguments in the "recovered memory" debate.

In 1992, the Saskatchewan town of Martensville was rocked by a sex abuse scandal. A complaint about a suspicious diaper rash from a parent of a toddler attending a local daycare led to a police investigation. After repeated and extensive interviewing, the children claimed to remember astonishing things including extensive sexual abuse, human sacrifice, a "Devil Church," and a Satanic cult known as The Brotherhood of the Ram. The owners of the daycare along with several other individuals—including five police officers—were eventually arrested. However, a closer examination of the police investigation identified some serious problems. Expert witnesses noted that the questions used in the interviews were leading and suggestive, with the police officers providing hints about the answers they wanted to hear (Jenish, 1994). Upon further examination, many charges were dropped. In fact, only one of the accused was convicted of a crime (molestation). The Saskatchewan government has since paid out millions of dollars to the other accused individuals whose lives were affected by these investigations.

While certainly well-meaning, the investigators—who were not trained to interview child witnesses—forgot a critical piece of information:

> *Memories are not like photographs perfectly depicting an event from our past. Instead, they are reconstructed each time we retrieve them, and can therefore be altered by a number of factors.*

The true story that opens this module demonstrates that our memories are not perfect. In a less disturbing example, cognitive psychologist and renowned memory researcher Ulric Neisser once recounted what he was doing on December 7, 1941, the day Japan attacked Pearl Harbor. Neisser was sitting in the living room listening to a baseball game on the radio when the program was interrupted with the news (Neisser, 2000). Or was he? He had certainly constructed a very distinct memory for this emotional event, but something must have gone wrong. Baseball season does not last through December. As this example demonstrates, even memory researchers are prone to misremembering. In this module we will examine how such misremembering occurs and what it says about how memories are constructed . . . and reconstructed.

How Memories Are Organized and Constructed

Listen to the Audio

Think about the last time you read a novel or watched a film. What do you recall about the story? If you have a typical memory, you will forget the proper names of locations and characters quickly, but you will be able to remember the basic plot for a very long time (Squire, 1989; Stanhope et al., 1993). The plot may be referred to as the *gist* of the story and it impacts us much more than characters′ names, which are often just details. As it turns out, much of the way we store memories depends on our tendency to remember the gist of things.

The Schema: An Active Organization Process

Listen to the Audio

The gist of a story gives us "the big picture," or a general structure for the memory; details can be added around that structure. Gist is often influenced by **schemas**, *organized clusters of memories that constitute a person's knowledge or beliefs about events, objects, and ideas*. Whenever we encounter familiar events or objects, these schemas become active and affect what we expect, what we pay attention to, and what we remember. Because we use these patterns automatically, it may be difficult to understand what they are, even though we use them throughout our lives. Here is an example; read the following passage through one time:

> The procedure is quite simple. First, you arrange things into different groups. Of course, one pile may be sufficient, depending on how much there is to do. If you have to go somewhere else due to lack of facilities, that is the next step; otherwise, you are pretty well set. It is important not to overdo things. That is, it is better to do too few things at once than too many. At first the whole procedure will seem complicated. Soon, however, it will become just another facet of life. After the procedure is completed, one arranges the materials into different groups again. Then they can be put into their appropriate places. Eventually they will be used once more, and the whole cycle will have to be repeated. (Bransford & Johnson, 1973)

At this point, if you were to write down the details of the paragraph solely from memory, how well do you think you would do? Most people do not have high expectations for themselves, but they would blame it on how vague the paragraph seems. Now, what if we tell you the passage is about doing laundry? If you read the paragraph a second time, you should see

that it is easier to understand, as well as to remember. The reason for this sudden improvement in memory is that when you were told the paragraph was about doing laundry, it activated your laundry schema—your personal collection of concepts and memories about this fun-filled chore. Once your schema was activated, you were prepared to make sense of the story and could likely fill in the gaps of your memory for the passage with stored knowledge from your schema in long-term memory (LTM).

An important aspect of schema-driven processing has to do with how we process information about ourselves. Schemas about the self are based on past experiences and are used to organize the encoding of self-relevant information in a way that can influence our responses (Markus, 1977). But self-schemas may serve an additional role during development. Some evidence suggests that the ability to form schemas, particularly self-schemas, plays a critical role in our ability to form memories about our lives.

Working the Scientific Literacy Model

How Schemas Influence Memory

Listen to the Audio

Although schemas are used to explain memory, they can be used to explain many other phenomena as well, such as the way we perceive, remember, and think about people and situations. In each case, schemas provide a ready-made structure that allows us to process new information more quickly than we could without this mental shortcut. This makes schemas extremely useful. But are they accurate?

What do we know about schemas?

Schemas are involved in all three stages of memory. First, they guide what we attend to during encoding. In the laundry example, your schema likely involves focusing attention on how the clothes are grouped and whether you have detergent and a washing machine available. Second, schemas influence how stored memories are organized. Information that is related, such as detergent and washing machine, will have stronger connections in the brain than unrelated items such as detergent and cat. This method of storage also influences how memories are retrieved. Different parts of a schema can serve as cues when it comes time to retrieve information. So, if you think about dirty clothes and a washing machine, these items serve as retrieval cues to allow you to remember the word *detergent*. However,

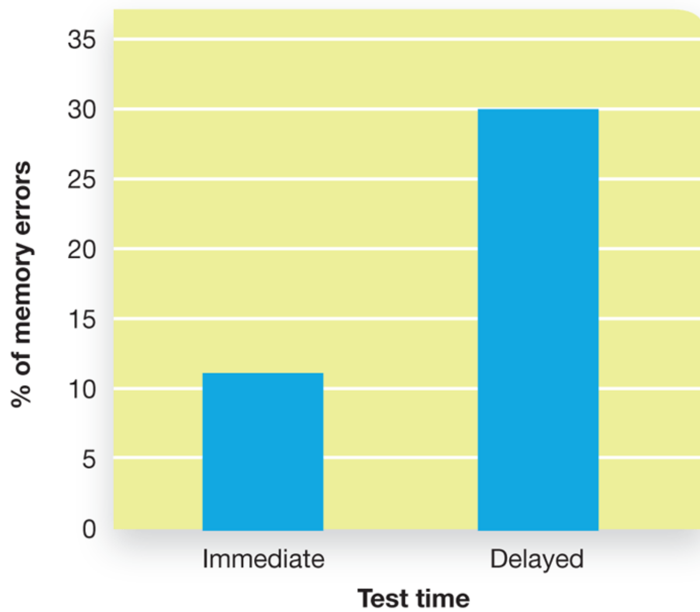
although schemas generally serve to aid memory, they can also sometimes cause us to fill in the gaps in our memories with information that is not entirely accurate.

How can science explain schemas?

Research indicates that we remember events using **constructive memory**, *a process by which we first recall a generalized schema and then add in specific details* (Scoboria et al., 2006; Silva et al., 2006). Where do these schemas come from? They appear to be products of culture and experience (e.g., Ross & Wang, 2010). For example, individuals within a culture tend to have schemas related to gender roles—men and women are each assumed to engage in certain jobs and to behave in certain ways (e.g., assuming that men will be the ones who do house repairs). Even if an individual realizes that these schemas are not 100% accurate (in fact, they can be far from accurate in some cases), they are likely to engage in schematic processing when having difficulty remembering something specific.

A study by Heather Kleider and her associates (2008) demonstrates how schemas influence memory quite well. These investigators had research participants view photographs of a handyman engaged in schema-consistent behaviour (e.g., working on plumbing) as well as schema-inconsistent tasks (e.g., folding a baby's clothing). Participants also viewed images of a stay-at-home mother performing schema-consistent (e.g., feeding a baby) and schema-inconsistent (e.g., hammering a nail) tasks. Immediately after viewing the photographs, participants were quite successful at remembering correctly who had performed what actions. However, after two days, what types of memory mistakes do you think the researchers found? As you can see from Figure 7.24, individuals began making mistakes, and these mistakes were consistent with gender schemas.

Figure 7.24 Schemas Affect How We Encode and Remember



In this study, memory was accurate when tested immediately, as shown by the small proportion of errors on the "immediate" side of the graph. After two days, however, participants misremembered seeing the schema-inconsistent tasks in line with stereotypes. For example, they misremembered the stay-at-home mother stirring cake batter even if they had actually seen the handyman doing it.

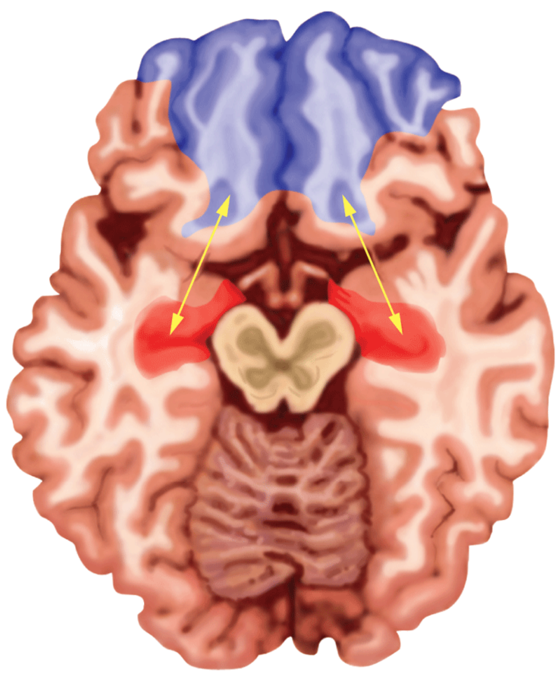
Source: Data from Kleider, H., Pezdek, K., Goldinger, S., & Kirk, A. (2008). Schema–driven source misattribution errors: Remembering the expected from a witnessed event. *Applied Cognitive Psychology*, *22*(1), 1–20.

Can we critically evaluate the concept of a schema?

The concept of a schema is certainly useful in describing our methods of mental organization, but some psychologists remain skeptical of its validity. After all, you cannot record brain activity and expect to see a *particular* schema, and individuals generally are not aware that they are using schematic processing. However, recent brain imaging studies suggest that schemas do exist and likely help with the process of memory consolidation (Wang &

Morris, 2010). Both encoding and retrieving information that was consistent with a schema learned during an experiment led to greater activity in a network involving parts of the medial temporal lobes (including the hippocampus) and the frontal lobes (van Kesteren, Fernandez, et al., 2010; van Kesteren, Rijpkema, et al., 2010; see Figure 7.25). Additionally, adding new information to an existing schema actually changes the expression of genes in the frontal lobes in order to strengthen connections between this region and the hippocampus (Tse et al., 2011). Thus, while we cannot identify the neural correlates for a *specific* schema like that for doing laundry, it *is* possible to see how schemas influence brain activity while new information is encoded and entered into the structure of our LTM.

Figure 7.25 A Brain Network Related to Processing Schemas



Brain imaging data suggest that encoding information consistent with a schema activates a network involving structures in the medial temporal lobe (including our friend, the hippocampus) and parts of the frontal lobes.

Source: Figure 5 from van Kesteren et al., (2013), *Trends in Neuroscience*, p. 2358.

Why is this relevant?

Research into the influence of schemas on memory highlights the fact that memory retrieval is an active process. Our memories are not photographs or mental videos that perfectly depict our previous experiences. Rather, we incorporate our own expectations and experiences into memory encoding, storage, and retrieval. In many cases, these schemas make our memory more efficient, as in the laundry example discussed earlier. However, it is also important to remember that our schemas also contain our own biases about different people, situations, and events. Remembering that our memories might be inaccurate will make it more likely that we will seek additional evidence from other sources (e.g., friends, relatives, textbooks). So, in addition to being critical consumers of information from outside sources, we should be critical consumers of information from our own memories as well.

Schemas and the Self

Listen to the Audio

Think back to the earliest memory you can recall: How old were you? It is likely that *you do not have any personal or autobiographical memories from before your third birthday*, a phenomenon known as **infantile amnesia**.

Research indicates that self-schemas begin to develop around the ages of 18 to 24 months (Howe, 2003). Without these schemas, it is difficult and maybe even impossible to organize and encode memories about the self. This is not a universal phenomenon, however. Other researchers taking a cross-cultural perspective have found that a sense of self emerges earlier among European Americans than among people living in eastern Asia, which correlates with earlier ages of first memories among European Americans (Fivush & Nelson, 2004; Ross & Wang, 2010). Why might this difference arise? The European American emphasis on developing a sense of self encourages thinking about personal experiences, which increases the likelihood that personal events—such as your third birthday party with that scary drunken clown or being chased by a dog—will be remembered. In contrast, Asian cultures tend to emphasize social harmony and collectiveness over individualism, resulting in a schema that is more socially integrated than in Westerners. This may explain the slightly later onset of autobiographical memory in Asian children. It will be interesting to see if this cultural difference changes as Asian cultures become more "Westernized."

Do these findings mean that we could get infants to remember early life events by teaching them to talk about themselves at an early age? This is not likely. The brains of young children are still developing, so the neural architecture necessary to form stable schemas is not yet in place (Newcombe et al., 2000).

The effects of self-schemas are not limited to our childhoods. Clinical psychology researchers have become particularly concerned with the ways in which these *self-schemas* may contribute to psychological problems. Consider a person with clinical depression—a condition that involves negative emotion, lack of energy, self-doubt, and self-blame. An individual with depression is likely to have a very negative self-schema, which means that they will pay attention to things that are consistent with the depressive symptoms, and will be more likely to recall events and feelings that are consistent with this schema. Thus the schema contributes to a pattern of thinking and focusing on negative thoughts. Fortunately, researchers have been able to target these schemas in psychotherapy. The evidence shows that by changing their self-schema, individuals are better able to recover from even very serious bouts of depression (Dozois et al., 2009).

Memory Reconstruction

Listen to the Audio

You've all heard the cliché, "You are what you eat." But it's also becoming increasingly clear to psychologists that "You are what you remember" (Wilson & Ross, 2003). As you read earlier in this module, our memories are organized to a large degree by our schemas, including self-schemas. There is no guarantee, however, that these schemas are 100% accurate. In fact, different motivations can influence which schemas are accessible to us in a given moment, thereby biasing our memory reconstruction. As a result of these motivational influences, the past that we remember is actually influenced by our mental state and by our view of ourselves in the present (Albert, 1977).

This type of biasing effect was nicely demonstrated in a study conducted by psychologists at Concordia University and the University of Waterloo (Conway & Ross, 1984). The researchers had one group of participants complete a study skills course while another group remained on a waiting list. The course itself proved completely ineffective, at least in improving study skills. The course did have an interesting effect on memory, however. Participants who completed the study course rated their previous study skills lower than they had rated them prior to taking the course; participants on the waiting list rated their study skills as being unchanged. Therefore, the study course participants revised their memories of their past abilities in a way that allowed them to feel as though they benefited from the course.

The results of such studies demonstrate that our memories are not stable, but instead change over time. Indeed, we have all experienced a **false memory**, *remembering events that did not occur, or incorrectly recalling details of an event*. It is important to remember that these incorrect memories do not necessarily indicate a dysfunction of memory, but rather reflect normal memory processes—which are inherently imperfect. As you read in the discussion of schemas, the elements that comprise a memory must be reconstructed each time that memory is retrieved. This reconstruction is influenced by the demands of the current situation. Psychologists have identified several ways in which our memories can be biased, and have explored how these biases can have many real-world implications, such as in the legal system.

The Perils of Eyewitness Testimony

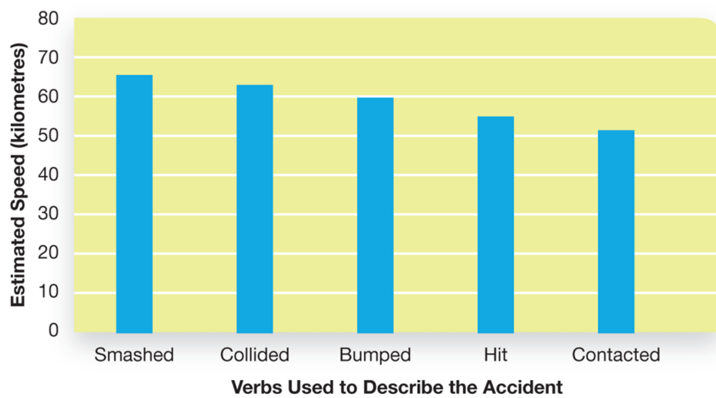
Listen to the Audio

Have you ever witnessed a crime or even a minor traffic accident? When asked later about what you witnessed, how accurate were your reports? Most of us feel quite confident in our ability to retrieve this type of information. However, psychologists have shown that a number of minor factors can dramatically influence the details of our "memories."

In one classic study, Elizabeth Loftus and John Palmer (1974) showed undergraduate research participants film clips of traffic accidents. Participants were asked to write down a description of what they had seen, and were then asked a specific question: "About how fast were the cars going when they smashed into each other?" However, the exact wording of this question varied across experimental conditions. For some participants, the word *smashed* was replaced by *collided*, *bumped*, *contacted*, or *hit*. The results of the study were stunning—simply changing one verb in the sentence produced large differences in the estimated speed of the vehicles (see Figure 7.26). At one extreme, the word *smashed* led to an estimate of 65.2 km/h. At the low end of the spectrum, the word *contacted* led to estimates of 51.2 km/h. So, changing the verb altered the remembered speed of the vehicles by 14 km/h. In a follow-up study, Loftus and Palmer also found that participants in the "smashed" condition were more likely to insert false details such as the presence of broken glass into their accident reports. This study was a powerful demonstration of the effect of question wording on memory retrieval and

provided police with important information about the need for caution when questioning witnesses.

Figure 7.26 The Power of a Word

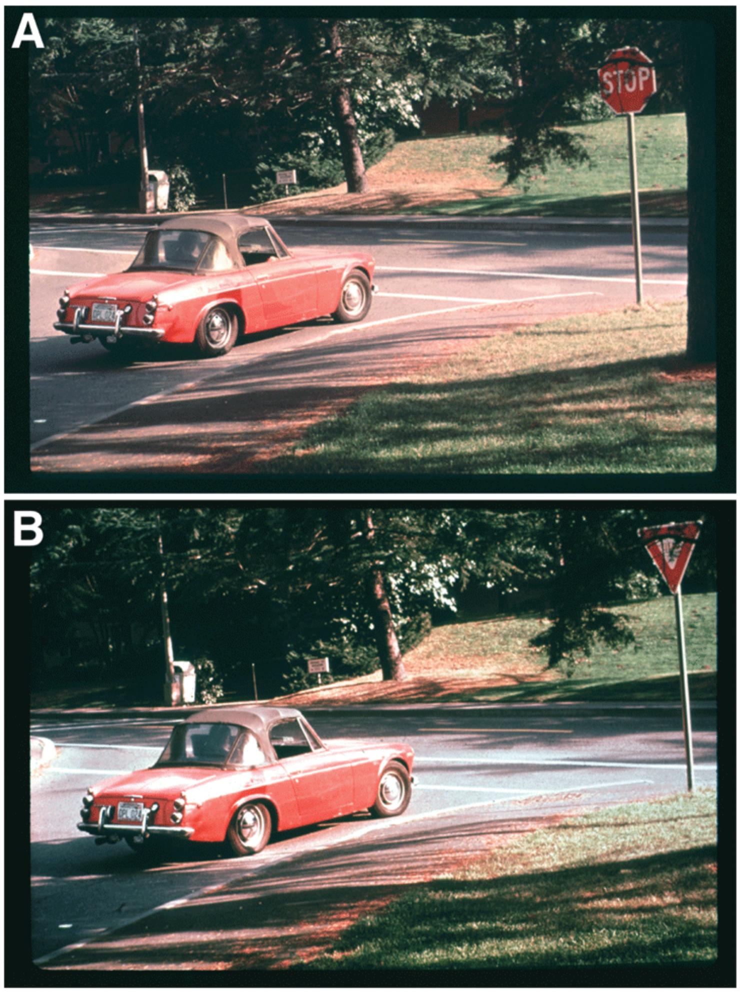


Simply changing the wording of a question altered participants' recollections of a filmed traffic accident. All participants viewed the same filmed traffic accidents and all participants received the identical question with the exception of one key verb: *smashed*, *collided*, *bumped*, *hit*, or contacted.

Source: Based on data from Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior, 13*, 585–589 (p. 586).

Another factor that can alter memories of an event—and that has implications for the legal system—is the information that is encoded after the event has occurred, such as rumours, news reports, or hearing about other people's perceptions of the event. If such information was accurate, it could improve people's memories; however, this type of information is not always accurate, which explains why jury members are asked to avoid reading about or watching TV reports related to the case with which they are involved. Psychologists have shown that this legal procedure is a wise one, as a number of studies have demonstrated the **misinformation effect**, *when information occurring after an event becomes part of the memory for that event*. In the original studies of this topic (Loftus, 1975), researchers attempted to use the misinformation effect to change the

details of people’s memories. For example, in one study, students viewed a videotape of a staged car crash. In the experimental conditions, participants were asked about an object that was not in the video, such as a yield sign (when in fact the scene had contained a stop sign). Later, when asked if they had seen a yield sign, participants in the experimental group were likely to say yes. As this experiment demonstrates, you can change the details of a memory by asking a leading question.



Participants in one study viewed the top photo and later were asked about the “yield sign,” even though they saw a stop sign. This small bit of misinformation was enough to get many participants to falsely remember seeing a yield sign. Similarly, participants who first viewed the bottom photo could be led to misremember seeing a stop sign with a single misleading question.

#Psych

“Fake News” and Inaccurate Social Media Information

When we think of “fake news,” we often imagine orange-skinned politicians shaking their little fists at reporters who are asking tough questions. In reality, this misinformation—which often appears on social media websites such as Twitter or Facebook (as well as on more difficult to classify sites such as Reddit and Imgur)—is designed to alter opinions about topics ranging from health decisions (Waszak et al., 2018) to voting preferences (Flynn et al., 2017). It might initially seem like “fake news” shouldn’t be a problem because readers or viewers should be able to quickly identify that information as being false. Unfortunately, a study of almost 8,000 U.S. students found that people are not very good at separating real news from fake news (Wineburg et al., 2016). The fact that news from a reputable source and “fake news” posted on Twitter is perceived as equivalent is problematic because, as you just read, misinformation can reduce the accuracy of our memories for important events.

“Fake news” can influence our memory in at least two ways. First, because this information is often presented in an emotionally arousing way (i.e., “clickbait”), it is easy to encode and is likely to be remembered. When we are encountering those topics later on, this emotional information can seem more familiar than boring facts. Psychology research shows that people are more likely to accept information that seems familiar (Swire et al., 2017). Additionally, people often forget the

context in which they learned a piece of information. **Source memory**, *the memory for how or where information was initially acquired*, is an important part of our ability to detect misinformation (Johnson et al., 1993). It is more difficult to remember the source of information when there are several people (or social media posts) presenting different information about the same topic.

Although the situation seems hopeless, several of the major social media platforms are attempting to fight against fake news. That said, we should all be vigilant and should use our critical-thinking skills when dealing with information we find on the internet.

Children as Eyewitnesses

Listen to the Audio

Children are particularly susceptible to misinformation effects and to the effects of a question's wording (Bruck & Ceci, 1999). In one study, five- and six-year-old children watched a janitor (really an actor) named Chester as he cleaned some dolls and other toys in a playroom. For half of the children, his behaviour was innocent and simply involved him cleaning the toys. For the other children, Chester's behaviour seemed abusive and involved him treating the toys roughly. The children were later questioned by two interviewers who were (1) accusatory (implying that Chester had been playing with the dolls when he should have been working), (2) innocent (implying that Chester was simply cleaning the dolls), or (3) neutral (not implying anything about Chester's behaviour). When the interviewer's tone matched what the children saw, such as innocent questioning about Chester when he treated the toys nicely or accusatory questioning when Chester was rough with the toys, the children's reports of the behaviour were quite accurate. However, when the interview technique did not match the observed behaviour (e.g., accusatory questioning when Chester had simply cleaned the toys), the children's responses matched the interviewer's tone. In other words, the tone of the interviewer altered the details of the information that the children retrieved and reported (Thompson et al., 1997).

Similar to adults, children are also dependent on schemas. In one study, researchers told children at school about their clumsy friend Sam Stone. On numerous occasions, they told funny stories about Sam's life,

including the times he broke a Barbie doll and tore a sweater. Later, the children met "Sam Stone." During his time in the classroom, he did not perform a single clumsy act. The following day, the teacher showed the children a torn book and a dirty teddy bear, but did not link Sam to these damaged items. When questioned a few weeks later, however, many of the three- and four-year-old children reported that Sam Stone had ruined these objects. Some even claimed to have witnessed these acts themselves (Leichtman & Ceci, 1995). These findings should not lead us to ignore the eyewitness testimony of children; but they should also remind us (and investigators) that memories—particularly those of children—are not stable and unchanging like a photograph. This research highlights how extremely important it is for legal professionals, such as the police, to practise investigative techniques that avoid biasing witnesses to crimes. Failure to do so could easily result in innocent people being convicted of crimes they did not commit or, conversely, guilty people being set free due to "reasonable doubt" because of questionable eyewitness testimony.

Psych@

Court: Is Eyewitness Testimony Reliable?

While trying to identify the individual responsible for a crime, investigators often present a lineup of a series of individuals (either in person or in photographs) and ask the eyewitness to identify the suspect. Given the constructive nature of memory, it should come as no surprise to hear that an eyewitness gets it wrong from time to time. The consequences of this kind of wrongful conviction are dire—an innocent person may go to jail while a potentially dangerous person stays free.

How can the science of memory improve this process? Here are the six main suggestions for reforming eyewitness identification procedures:

1. *Employ double-blind procedures.* Elsewhere in this book, we discussed how double-blind procedures help reduce experimenter bias. Similarly, a double-blind lineup (i.e., the investigator in the room with the eyewitness has no knowledge of which person is the actual suspect) can prevent an investigator from biasing an eyewitness, either intentionally or accidentally.
2. *Use appropriate instructions.* For example, the investigator should include the statement, “The suspect might not be present in the lineup.” Eyewitnesses often assume the guilty person is in the lineup, so they are likely to choose a close match. This risk can be greatly reduced by instructing the eyewitness that the correct answer may be “none of the above.”
3. *Compose the lineup carefully.* The lineup should include individuals who match the eyewitness’s description of the perpetrator, not the investigator’s beliefs about the suspect.
4. *Use sequential lineups.* When an entire lineup is shown simultaneously, this may encourage the witness to assume one of the people is guilty, so they choose the best candidate. If the people in the lineup are presented one at a time, witnesses are less likely to pick out an incorrect suspect because they are willing to consider the next person in the sequence.
5. *Require confidence statements.* Eyewitness confidence can change as a result of an investigator’s response, or simply by seeing the same suspect in multiple lineups, neither of which make the testimony any more accurate. Therefore,

confidence statements should be taken in the witness's own words after an identification is made.

6. *Record the procedures.* Eyewitness researchers have identified at least a dozen specific things that can go wrong during identification procedures. By recording these procedures, expert witnesses can evaluate the reliability of testimony during hearings.

When these procedures are followed, eyewitness testimony *can* provide useful—and accurate—information (Wixted et al., 2018). Fortunately, many attorneys and police officers have consulted with memory researchers in order to improve the procedures used when questioning eyewitnesses. In the past decade, Canadian legal experts produced the *Report of the Federal/Provincial/Territorial Heads of Prosecutions Subcommittee on the Prevention of Wrongful Convictions* (Public Prosecution Service of Canada, 2011). This 233-page document presents recommendations to the legal community for the use of eyewitness testimony, among other investigative practices, and highlights the need for testimony from experts, including psychologists.

Watch Thinking Like a Psychologist: Police Lineup

Imagination and False Memories

Listen to the Audio

Because our memories are not always as accurate as we would like them to be, people use a number of techniques to try to help themselves retrieve information. One of these techniques is to imagine the situation that you are trying, but failing, to remember. However, although this strategy seems logical at first, the results of several studies suggest that the retrieved memories may not be very accurate. Research indicates that repeatedly imagining an action such as breaking a toothpick makes it very difficult for people to remember whether or not they performed that action (Goff & Roediger, 1998). In fact, imagining events can often lead to **imagination inflation**, *the increased confidence in a false memory of an event following repeated imagination of the event*. The more readily and clearly we can imagine events, the more certain we are that the memories are accurate.

To study this effect, researchers created a list of events that may or may not have happened to the individuals in their study (e.g., got in trouble for falsely calling 911, found a $10 bill in a parking lot). The volunteers were first asked to rate their confidence that the event happened. In sessions held over a period of days, participants were asked to imagine these events, until finally they were asked to rate their confidence again. For each item they were asked to imagine, repeated imagination *inflated* their confidence in the memory of the event even if they initially reported that the event had not occurred (Garry et al., 1996; Garry & Polaschek, 2000).

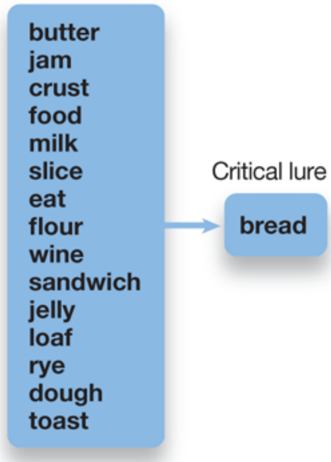
Importantly, imagination inflation is very similar to **guided imagery**, *a technique used by some clinicians (and some police investigators) to help people recover details of events that they are unable to remember*. It involves a guide giving instructions to participants to imagine certain events. Like the misinformation effect, guided imagery can be used to alter memories for actual events; it can also create entirely false memories. In other words, attempting to imagine an event can implant new—and false—events into a person's memory.

Creating False Memories in the Laboratory

Listen to the Audio

Given that several research studies have shown that false memories are fairly easy to create, and given that such memories can have dramatic and tragic consequences when they appear in clinical or legal settings, it became important for researchers to develop techniques that would allow them to study false memories in more detail. The first of these techniques to be used was the Deese-Roediger-McDermott (DRM) paradigm (see Figure 7.27). In the **DRM procedure**, *participants study a list of highly related words called semantic associates* (which means they are associated by meaning). The word that would be the most obvious member of the list just happens to be missing. This missing word is called the *critical lure*. What happens when the participants are given a memory test? A significant proportion of participants remember the critical lure, even though it never appeared on the list (Deese, 1959; Roediger & McDermott, 1995). When individuals recall the critical lure, it is called an *intrusion*, because a false memory is sneaking into an existing memory.

Figure 7.27 A Sample Word List and Its Critical Lure for the DRM Procedure



The words on the left side are all closely related to the word *bread*—but *bread* does not actually appear on the list. People who study this list of words are very likely to misremember that *bread* was present.

Source: From Roediger, H., & McDermott, K. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 803–814. American Psychological Association.

The fact that people make intrusion errors is not particularly surprising. However, the strength of the effect is astonishing. In routine studies, the DRM lures as many as 70% of the participants. The most obvious way to reduce this effect would be to simply explain the DRM procedure and warn participants that intrusions may occur. Although this approach has proved effective in reducing intrusions, false memories still occur (Gallo et al., 1997). Obviously, intrusions are very difficult to prevent, but not because memory is prone to mistakes. In fact, memory is generally accurate and extremely efficient, given the millions of bits of information we encounter every day. Instead, the DRM effect reflects the fact that normal memory processes are constructive.

A second method of creating false memories in the laboratory comes from doctored photographs or videos. For instance, researchers at the University of Victoria and their colleagues exposed undergraduate research participants to altered photographs showing the participant and

their parent taking a ride on a hot-air balloon, an event that did not actually occur (Wade et al., 2002). For this type of experiment to work, the volunteers in the study had to recruit the help of their family. Their parents provided pictures of the participant from early childhood, along with an explanation of the event, the location, and the people and objects in the photo. The researchers took one of the pictures and digitally cut and pasted it into a balloon ride. On three occasions the participants went through the set of pictures, the true originals plus the doctored photo, in a structured interview process (the kind designed to help police get more details from eyewitnesses). By the end of the third session, half the participants had some memory for the balloon ride event, even though it never occurred (Wade et al., 2002).

Photographic images such as the ones used in the hot-air balloon study leave it to the participant to fill in the gaps as to what "happened" on their balloon ride. Other researchers have gone so far as to create false videotaped evidence of an event (Nash, Wade et al., 2009). For this method, a volunteer was videotaped watching a graduate student perform an action. The researchers also videotaped the graduate student performing an additional action that the volunteer did not witness. The videos were then spliced together to show the volunteer watching an event that she, in reality, did not actually see. Now imagine you were shown a video of yourself watching an action you had not seen before—would you believe it? In fact, a significant portion of the individuals did form memories of the events they had never witnessed. These experiments demonstrate how powerful images can be in creating false memories, and highlight some of the perils of using guided imagery techniques in clinical and legal settings.

In one study of false memory, true photos were obtained from volunteers' families (top), and were edited to look like a balloon ride (bottom). About

half of the volunteers in this study came to recall some details of an event that never happened to them.

Courtesy of K. Wade, M. Garry, J. Read, and S. Lindsay.

The Danger of False Remembering

Listen to the Audio

In the early 1990s, Beth Rutherford sought the help of her church counsellor to deal with personal issues. During their sessions, the counsellor managed to convince her that her father, a minister, had raped her. The memory was further elaborated so that she remembered becoming pregnant and that her father had forced her to undergo an abortion using a coat hanger. You can imagine what kind of effects this had on the family. Her father had little choice but to resign from his position, and his reputation was left in shambles. Although it can be difficult to prove some false memories, this incident is particularly disturbing because it *could* have been supported by medical evidence. When a medical investigation was finally conducted, absolutely no evidence was found that Beth had ever been raped or that she had ever been pregnant (Loftus, 1997).

In this example, Beth's therapist believed that Beth had experienced a **recovered memory**, *a memory of a traumatic event that is suddenly recovered after blocking the memory of that event for a long period of time*, often many years. However, the topic of recovered memories is a contentious one. In the past three decades, psychologists have performed a great deal of research investigating whether it is possible to suppress a memory and whether there are research tools available to help us distinguish between memories that are accurate and those that are not.

This idea that we suppress traumatic memories is popularly known as *repression* from Freudian psychoanalysis (see Module 12.3). According to this idea, a repressed memory could still affect other psychological processes, leading people to suffer in other ways such as experiencing depression. This school of thought suggests that if a repressed memory can be recovered, then a patient can find ways to cope with the trauma. Some therapists espouse this view and use techniques such as hypnosis and guided imagery to try to unearth repressed memories. However, given the research we have discussed about how false memories can be implanted through these types of techniques, there is an obvious danger in the use of these methods.

Can we suppress our memories of traumatic life events? As it turns out, it is *possible*, although it is difficult to determine how common it is. In one survey study, researchers examined the testimony of people who had been imprisoned in Camp Erika, a Nazi concentration camp in The Netherlands, in the early 1940s (Wagenaar & Groeneweg, 1990). Most of the prisoners were able to provide detailed information about their time in the concentration camp, but a minority of prisoners did not remember many emotional events during their imprisonment, including the names and appearances of people who tortured them and the fact that they had even witnessed murders. But being able to suppress a horrific memory is very different from then recovering that memory years later.

Recovered memories, like many other types of long-term memory, are difficult to study because one can rarely determine if they are true or false. This uncertainty has led to the **recovered memory controversy**, *a heated debate among psychologists about the validity of recovered memories* (Davis & Loftus, 2009). On one side of the controversy are some clinical mental health workers (although certainly not the majority) who regularly attempt to recover memories they suspect have been repressed. On the opposing side are the many psychologists who point out that the

techniques that might help “recover” a memory bear a striking resemblance to those that are used to create false memories in laboratory research; they often involve instructions to remember, attempts to form images, and social reinforcement for reporting memories (Spanos et al., 1994). How can this disagreement be resolved?

One method is to use brain imaging to differentiate true and false memories. Psychologists have found that when people recount information that is true, the visual and other sensory areas of the brain become more active. When revealing falsely remembered information, these same individuals have much less activity in the sensory regions—the brain is not drawing on mental imagery because it was not there in the first place (Dennis et al., 2012; Stark et al., 2010). Interestingly, these brain results do not always map onto the participants’ conscious memories of what they had seen. So, this method might be able to distinguish between true and false memories better than the participant himself (Johnson et al., 2012). However, although these neuroimaging results are promising, these studies did not use stimuli that were as emotional as the recovered memories patients report. Therefore, as with most areas of psychology, much more research is needed in this controversial area.

Module 7.3 Summary

Listen to the Audio

7.3a Know . . . the key terminology used in discussing how memories are organized and constructed.

Review Module 7.3

Start Over Swap

0/11 REVIEWED · 0 MASTERED

false memory

Previous Next Got It!

7.3b Understand . . . how schemas serve as frameworks for encoding and constructing memories.

Schemas guide our attention, telling us what to expect in certain circumstances. They organize long-term memories and provide us with

cues when it comes time to retrieve those memories.

7.3c Understand . . . how psychologists can produce false memories in the laboratory.

Psychologists have found that a number of factors contribute to the construction of false memories, including misinformation, imagination inflation, and the semantic similarities used in the DRM procedure.

7.3d Apply . . . what you have learned to judge the reliability of eyewitness testimony.

Apply Activity

Match the situation to the type of memory bias it is depicting. You will need to use some memory biases more than once. Select "Check Your Understanding" when you are ready.

Imagination Inflation Effect	Misinformation Effect	Biased Schemas
Jennifer thought of the mean statement that she wished she'd made to a rude coworker. Over time, she started to believe that she'd actually said that statement.	Cleetus was watching a football game in the stadium and saw, in person, an important play in the game. However, after reading several people's opinions about the game online, his memory now includes a mixture of his own—and their—accounts of that play.	Malcolm couldn't remember which of his parents had done the family's taxes the year before. Although his mother had actually filled in the forms, Malcolm remembered his father, an accountant, doing it.
Luke kept thinking about the stupid joke he'd made at a party, and about how embarrassed he was when no one laughed. He kept thinking about how nice it would have been if no one had noticed his embarrassment. Over time, his memory of the event changed to be less upsetting.	Rita confused the information that she'd read in one of her tabloid magazines with her own memory for an event.	

Check Your Understanding

7.3e Analyze . . . the arguments in the “recovered memory” debate.

You should first understand the premise behind the idea of recovered memories: Some people believe that if a memory is too painful, it might

be blocked from conscious recollection, only to be recovered later through therapeutic techniques. Others argue that it is difficult to prove that a “recovered” memory is actually real, as opposed to falsely constructed. Given how easy it is to create false memories, they argue, any memory believed to be recovered should be viewed with skepticism.

Chapter 8
Thought and Language

Listen to the Audio

8.1 The Organization of Knowledge

- Concepts and Categories
- Working the Scientific Literacy Model: Priming and Semantic Networks
- Experience, the Brain, and Culture
- Module 8.1 Summary

8.2 Problem Solving, Judgment, and Decision Making

- Defining and Solving Problems
- Judgment and Decision Making
- Working the Scientific Literacy Model: Maximizing and Satisficing in Complex Decisions
- Module 8.2 Summary

8.3 Language and Communication

- What Is Language?
- The Development of Language
- Genes, Evolution, and Language
- Working the Scientific Literacy Model: Genes and Language

Module 8.3 Summary

Module 8.1 The Organization of Knowledge

Listen to the Audio

Login/Shutterstock

Learning Objectives

8.1a Know . . . the key terminology associated with concepts and categories.

8.1b Understand . . . theories of how people organize their knowledge about the world.

8.1c Understand . . . how experience and culture can shape the way we organize our knowledge.

8.1d Apply . . . your knowledge to identify prototypical examples.

8.1e Analyze . . . the claim that the language we speak determines how we think.

Have you ever become lost on the web? It happens to most of us at some point. Imagine going to a site like Wikipedia to answer a homework question about Albert Einstein, then you see he won the Nobel Prize and click that link to see exactly what that entails, and next thing you know a half hour has passed and you are reading that the first known usage of the word pizza was over a millennium ago in the coastal Italian town of Gaeta. You know you have become lost because you cannot retrace the steps you took to get Gaeta from Einstein's Nobel Prize. What makes those steps possible is that no facts exist in isolation; all information is interconnected. This holds true whether you are following links on the internet or searching your own memory for some bit of trivia. One of the fundamental puzzles of cognitive psychology is to understand what links together all the facts that comprise knowledge of the world, and to learn how those links are formed and activated when we learn and think.

Each of us has amassed a tremendous amount of knowledge in the course of our lifetime. Indeed, it is impossible to put a number on just how many facts each of us knows. Imagine trying to record everything you ever learned about the world—how many books could you fill? Instead of asking how much we know, psychologists are interested in how we keep track of it all. In this module, we will explore what those processes are like and how they work. We will start by learning about the key terminology before presenting theories about how knowledge is stored over the long term.

Concepts and Categories

Listen to the Audio

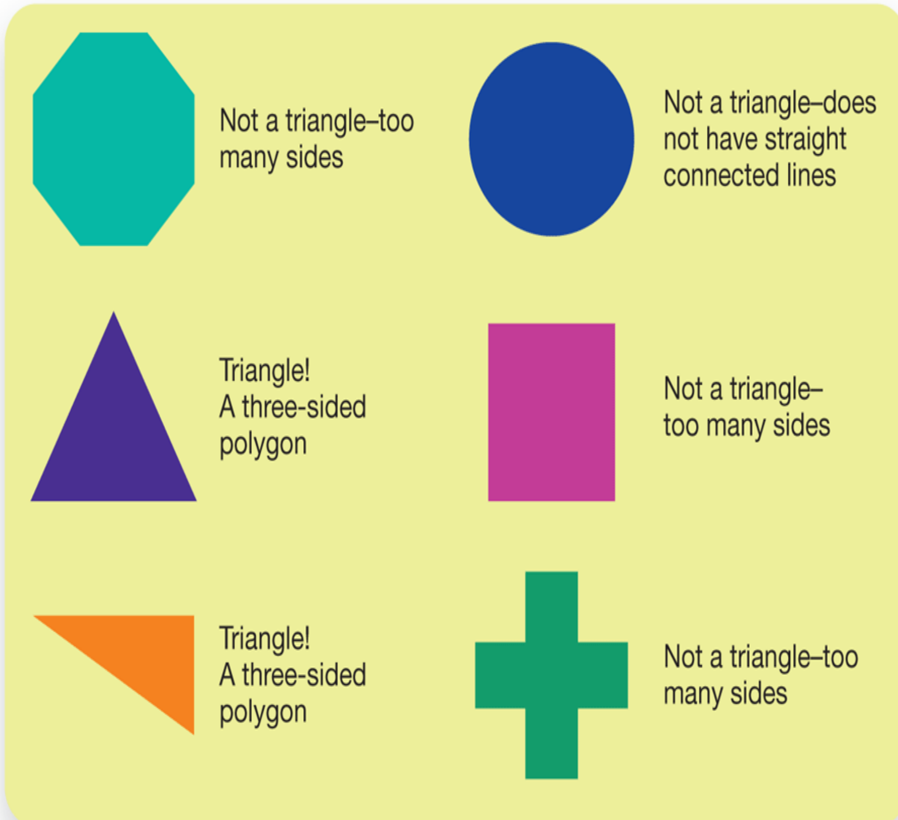
A **concept** *is the mental representation of an object, event, or idea*. Although it seems as though different concepts should be distinct from each other, there are actually very few independent concepts. You do not have just one concept for *chair*, one for *table*, and one for *sofa*. Instead, each of these concepts can be divided into smaller groups with more precise labels, such as *arm chair* or *coffee table*. Similarly, all of these items can be lumped together under the single label *furniture*. Psychologists use the term **categories** to refer to these *clusters of interrelated concepts*; the act of forming or thinking about these groups is called *categorization*. So how does categorization work? Psychologists and other scientists have discovered at least two processes people use to categorize, so the answer is, “It depends.”

Rule-Based Categorization

Listen to the Audio

The earliest approach to the study of categories is **rule-based categorization**; *categorizing objects or events according to a certain set of rules or by a specific set of features*—something similar to a dictionary definition (Rouder & Ratcliffe, 2006). Definitions do a fine job of explaining how people categorize items, at least in certain situations. For example, a triangle can be defined as "a figure (usually, a plane rectilinear figure) having three angles and three sides" (*Oxford English Dictionary*, 2011). Using this definition, you should find it easy to categorize the triangles in Figure 8.1.

Figure 8.1 Using the Definition of a Triangle to Categorize Shapes



Rules do not tell the full story of how categorization works, however. One of the major problems we confront in this process is **graded membership**—*the observation that some concepts appear to make better category members than others*. For example, see if the definition in Table 8.1 fits your definition of *bird* and then categorize the items in the table.

Table 8.1 Categorizing Objects According to the Definition of *Bird*

Table 8.1 Categorizing Objects According to the Definition of *Bird*

Definition: "[A] feathered, warm-blooded, vertebrate of the class Aves, having a beak and wings, laying eggs and usually able to fly." (*Canadian Oxford Dictionary, 2nd ed.*, 2005)
Now categorize a set of items by answering *yes* or *no* regarding the truth of the following sentences:
1. A sparrow is a bird.
2. An apple is a bird.
3. A penguin is a bird.

Ideally, you said yes to the sparrow and penguin, and no to the apple. But did you notice any difference in how you responded to the sparrow and penguin? Psychologists have researched rule-based categorization using a behavioural measure known as the *sentence- verification technique*, in which volunteers wait for a sentence to appear in front of them on a computer screen and respond as quickly as they can with a yes or no answer to statements such as "A sparrow is a bird" or "A penguin is a bird." The choice the participant makes, as well as their reaction time to respond, is measured by the researcher. Sentence verification shows us that some members of a category are recognized faster than others (Olson et al., 2004; Rosch & Mervis, 1975). In other words, subjects almost always answer "yes" faster to sparrow than to penguin. This seems to go against a rule-based categorization system because both sparrows and penguins are equally good fits for the definition, but sparrows are somehow perceived as being more bird-like than penguins. Thus, a complete approach to categorization must also explain how "best examples" influence how we categorize items.

Categorization by Comparison

Listen to the Audio

When you hear the word *bird*, what mental image comes to mind? Does it resemble an ostrich? Or is your image closer to a robin, sparrow, or blue jay? The likely image that comes to mind when you imagine a bird is what psychologists call an **exemplar**, *a specific example that best represents a category*. Alternatively, a **prototype** *is a mental representation of an average category member* (Ashby & Rosedahl, 2017; Divjak & Arppe, 2013). Exemplars and prototypes are both mental representations of categories; the difference is that an exemplar is a real example, whereas a prototype can be thought of as an image that combines typical features of category. Both allow for classification by comparison. That way, if you encounter a little winged creature you have never seen before, its basic shape—maybe just its silhouette—can be compared to your prototype or an exemplar of a bird (Figure 8.2). A match will then be made and you can then say, "Look at that bird." Notice how different this process is from rule-based categorization: No rules or definitions are involved—just a set of similarities in overall shape and function.

Figure 8.2 A Prototypical Bird

Left: chatursunil/Shutterstock; centre: Al Mueller/Shutterstock; right: Leo/Shutterstock

The main advantage of comparison approaches to categorization is that they better explain why some category members make better examples than others. According to rule-based approaches, ostriches are birds just as much as robins—they can be identified using the same set of rules. Although that may be scientifically true, it does not match up with how humans behave—it takes longer to verify that that ostriches are birds. This is simply because ostriches do not resemble the rest of the family very well,while robins are much closer to the prototypical bird.

Now that you have read about categorization by rules and by comparison, you might wonder which approach is correct. Research says that we can

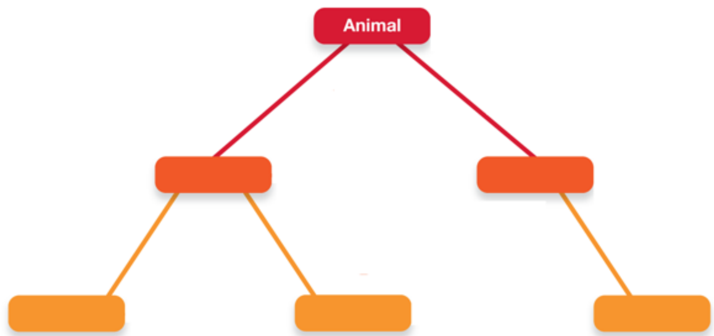
follow either approach—the choice really depends on how complicated a category or a specific example might be. If there are a few major distinctions between items, we use resemblance; if there are complications, we switch to rules (Rouder & Ratcliff, 2004, 2006). For example, if you walk through a park at night and a bat darts right by you, your first impression might be "That bird almost hit me!" That's because the bat resembled a prototypical bird in many ways. However, if you then realized it was a bat, you will recall that a bat follows a different set of rules - it is a mammal, not a bird. In other words, it has hair rather than feathers, gives live birth rather than laying eggs, and is far creepier.

Networks and Hierarchies

Listen to the Audio

Rules and comparisons only explain part of how we organize information. Each concept that we learn about has similarities to other concepts and each category has similarities with other categories. These connections among ideas can be represented in a diagram known as a **semantic network**, *an interconnected set of nodes (or concepts) and the links that join them to form a category*. Figure 8.3. shows an example of a typical category structure that might be found among people who share a language and culture (although each individual will have their own associations based on personal experience). There are two important features: *nodes* are circles that represent concepts, and *links* connect them together to represent the structure of a category as well as the relationships among different categories. In these networks, similar items have more, and stronger, connections than unrelated items (Collins & Loftus, 1975; Morais, Olsson, & Schooler, 2013).

Figure 8.3 A Partial Semantic Network for "Animal"*Animal*



The concept of *Animal* is connected to many other concepts.

1 of 4 Previous Next

The nodes include the basic-level categories, *Bird* and *Fish*. Another node represents the broader category of *Animal*, while the lowest three nodes represent the more specific categories of *Robin*, *Emu*, and *Trout*.

Source: Based on Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of Verbal Learning and Verbal Behavior*, *8*, 240–248.

Something you may notice about Figure 8.3 is that it is arranged in a *hierarchy*—that is, it consists of a structure moving from general to very specific. This organization is important because different levels of the category are useful in different situations. The most frequently used level, in both thought and language, is the *basic-level category*, which is located in the middle row of the diagram (where birds and fish are) (Johnson & Mervis, 1997; Rosch et al., 1976). A number of qualities make the basic-level category unique:

- Basic-level categories are the terms used most often in conversation.
- They are the easiest to pronounce.
- They are the level at which prototypes exist.

- They are the level at which most thinking occurs.

To get a sense for how different category levels influence our thinking, we can compare sentences referring to an object at different levels. Consider what would happen if someone approached you and made any one of the following statements:

- There's an *animal* in your yard.
- There's a *bird* in your yard.
- There's a *gray jay* in your yard

The second sentence—"There's a bird in your yard"—is probably the one you are most likely to hear, and it makes reference to a basic-level category (birds). Many people would respond that the choice of *animal* as a label indicates confusion, claiming that if the speaker knew it was a *bird*, they should have said so; otherwise, it sounds like they are trying to figure out which kind of animal they are looking at. Indeed, *superordinate categories* like *animal* are generally used when someone is uncertain about an object or when he or she wishes to group together a number of different examples from the basic-level category (e.g., birds, cats, dogs). In contrast, when the speaker identifies a *subordinate-level category* like *gray jay*, it suggests that there is something special about this particular type of bird. It may also indicate that the speaker has expert-level knowledge of the basic category and that using the more specific level helps get their point across in the intended way—perhaps they recall how the Canadian Geographical Society lobbied to have these jays become the national bird.

In order to demonstrate the usefulness of semantic networks in our attempt to explain how we organize knowledge, complete this easy test based on the animal network in Figure 8.3. If you were asked to react to

dozens of sentences, and the following two sentences were included among them, which do you think you would mark as "true" the fastest?

- *A robin is a bird*.
- *A robin is an animal*.

As you can see in the network diagram, *robin* and *bird* are closer together; in fact, to connect *robin* to *animal*, you must first go through *bird*. Sure enough, people regard the sentence "A robin is a bird" as a true statement faster than "A robin is an animal."

Now consider another set of examples. Which trait do you think you would verify faster?

- *A robin has wings*.
- *A robin eats*.

Using the connecting lines as we did before, we can predict that it would be the first statement about wings. As research shows, our guess would be correct. These results demonstrate that how concepts are arranged in semantic networks can influence how quickly we can access information about them.

Working the Scientific Literacy Model

Priming and Semantic Networks

Listen to the Audio

The thousands of concepts and categories in long-term memory are not isolated, but connected in a number of ways. What are the consequences of forming all the connections in semantic networks?

What do we know about semantic networks?

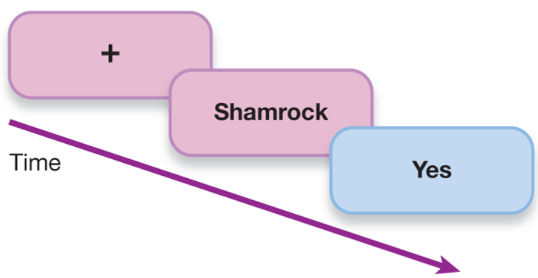
In your daily life, you notice the connections within semantic networks anytime you encounter one aspect of a category and other related concepts seem to come to mind. Hearing the word *fruit*, for example, might lead you to think of an apple, and the apple may lead you to think of a computer, which may lead you to think of a paper that is due tomorrow. These associations illustrate the concept of **priming**—*the activation of individual concepts in long-term memory*. Interestingly, research has shown that priming can also occur without your awareness; *fruit* may not have brought the image of a watermelon to mind, but the concept of a watermelon may have been primed nonetheless.

How can science explain priming effects?

Psychologists can test for priming through reaction time measurements, such as those in the sentence verification tasks discussed earlier or through a method called the *lexical decision task*. With the lexical decision method, a volunteer sits at a

computer and stares at a focal point. Next, a string of letters flashes on the screen. The volunteer responds yes or no as quickly as possible to indicate whether the letters spell a word (see Figure 8.4). Using this method, a volunteer should respond faster that *apple* is a word if it follows the word *fruit* (which *is* semantically related) than if it follows the word *bus* (which is *not* semantically related).

Figure 8.4 A Lexical Decision Task

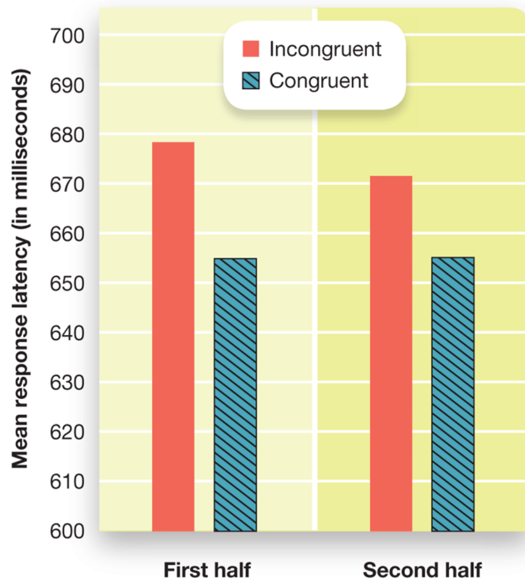


In a lexical decision task, an individual watches a computer screen as strings of letters are presented. The participant must respond as quickly as possible to indicate whether the letters spell a word (e.g., *desk*) or are a non-word (e.g., *sekd*).

Given that lexical decision tasks are highly controlled experiments, we might wonder if they have any impact outside of the laboratory. One test by Jennifer Coane suggests that priming does occur in everyday life (Coane & Balota, 2009). Coane's research team invited volunteers to participate in lexical decision tasks about holidays at different times of the year. The words they chose were based on the holiday season at that time. Sure enough, without any laboratory priming, words such as *nutcracker* and *reindeer* showed priming effects at times when they were *congruent* (or "in season") in December, relative to other times of the year (see Figure 8.5). Similarly, words like *leprechaun* and *shamrock* showed a priming effect during the

month of March. Because the researchers did not instigate the priming, it must have been the holiday spirit at work: Decorations and advertisements may serve as constant primers.

Figure 8.5 Priming Affects the Speed of Responses on a Lexical Decision Task



Average response times were faster when the holiday-themed words were *congruent* (in season), as represented by the blue bars. This finding is consistent for both the first half and the second half of the list of words.

Source: Based on Coane, J. H., & Balota, D. A. (2009). Priming the Holiday Spirit: Persistent Activation due to Extraexperimental Experiences Fig. 1, Pg. 1126, *Psychonomic Bulletin & Review*, *16*(6), 1124–1128, 2009.

Can we critically evaluate this information?

Priming influences thought and behaviour, but is certainly not all-powerful. On the one hand, priming does a very good job of explaining many language phenomena, such as the fact that we rarely notice when words have multiple meanings. If you hear the children's rhyme, "Humpty Dumpty had a great fall," you can easily imagine a character tumbling from his perch high atop a wall. However, if that is followed by, "but his winter was

terrible," you can probably sense a delay and a little surprise as you realize the joke—you had be primed to expect only one sense of the word *fall* while the comic had you primed to expect another. On the other hand, priming can be very weak at times, particularly when describing more complex combinations of behaviour. You are very unlikely to become clumsy and fall down just because you encountered that rhyme—not even if you get a whole thesaurus entry of synonyms to go along with it.

The effects of priming can vary a great deal, and some published experiments have been very difficult to replicate—an important criterion of quality research. In fact, there have been very open debates at academic conferences and in peer-reviewed journals about the best way to conduct the research and how to interpret the results (Cesario, 2014; Klatzky, Creswell, 2014). It may be safest to say that priming is weakest when applied to large, physical concepts such as a person's posture movements. However, it is very powerful when applied to the way language activities concepts and categories. Even a fishing enthusiast is likely to have overlooked the word *perch* in the previous paragraph while remaining upright, physically unaffected by the word *tumbling*" in the very same sentence.

Why is this relevant?

Advertisers know all too well that priming is more than just a curiosity; it can be used in a controlled way to promote specific behaviours. For example, cigarette advertising is not allowed on television stations, but large tobacco companies can sponsor anti-smoking ads. Why would a company advertise against its own product? Researchers brought a group of smokers into the lab to complete a study on television programming and subtly included a specific type of advertisement between segments (they did not reveal the true purpose of the study until after it was completed).

Their participants were four times as likely to light up after watching a tobacco-company anti-smoking ad than if they saw the control group ad about supporting a youth sports league (Harris et al., 2013). It would appear that while the verbal message is "don't smoke," the images actually prime the behaviour. Fortunately, more healthful behaviours have been promoted through priming; for example, carefully designed primes have been shown to reduce mindless snacking (Papies & Hamstra, 2010) and binge-drinking in university students (Goode et al., 2014).

Experience, the Brain, and Culture

Listen to the Audio

In the first part of this module, we examined how we group together concepts to form categories. However, it is important to remember that these processes are formed, at least in part, on our personal, day-to-day perceptions and activities. Of course, we must account for the fact that much of what we experience is based within a culture, ranging from the food we eat to how we relate to our families and the community. In this section of the module, we examine the role of experience on the ways we organize vast stores of information.

Experience and Categorization

Listen to the Audio

People integrate new stimuli into categories based on what they have seen, heard about, or read before. When we encounter a new item and it closely matches a category we are familiar with, these procedures lead to fast and accurate categorization-by-comparison. If you see a plate with two slices of bread on it with some cheese in the middle, you can easily retrieve from memory an exemplar—perhaps a grilled cheese sandwich you ate yesterday. Doing so will lead you to infer that this new object is a sandwich, even if it is a type of sandwich that you might not have encountered before. At other times, you might encounter something you know a little about, but have never personally experienced. Imagine a student visits a Turkish restaurant for the first time and spots something that looks like a small, canoe-shaped pizza. Although neither prototype—canoe or pizza—is satisfactory, he remembers his friend from Turkey recommending an item that fits this description. Considering each of the characteristics she described, the student can confidently identify it as *pide*.

Experience helps us use comparison techniques quickly and accurately. However, there are also times when our reliance on previous experience can lead us astray. In a series of studies with medical students and practising physicians, Geoffrey Norman and colleagues at McMaster University found that recent exposure to an example from one category can bias how people diagnose new cases (Leblanc et al., 2001; Norman, Brooks, et al., 1989; Norman, Rosenthal, et al., 1989). In one experiment,

medical students were taught to diagnose different skin conditions using written rules as well as photographs of these diseases. Some of the photographs were typical examples of that disorder, whereas other photographs were unusual cases that resembled other disorders. When tested later, the participants were more likely to rely on the previously viewed photographs than they were on the rules (a fact that would surprise most medical schools); in fact, the unusual photographs viewed during training even led to wrong diagnoses for test items that were textbook examples of that disorder (Allen et al., 1992)! This shows the power that our memory can have on how we take in and organize new information. As an aside, expert physicians were accurate over 90% of the time in most studies, so you can still trust your doctor.

Categories in the Brain

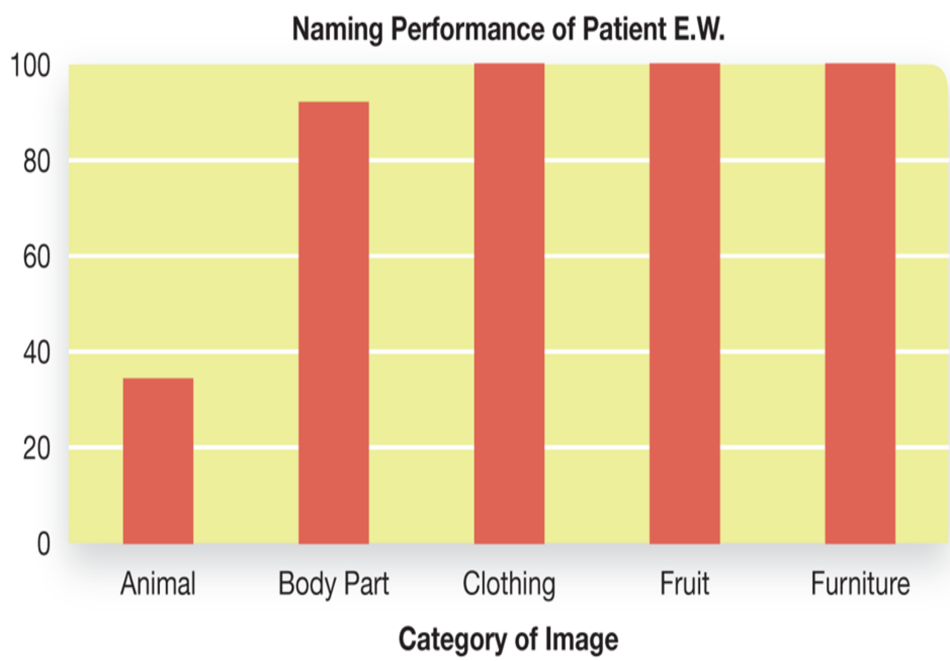
Listen to the Audio

Studies of neurological patients provide a unique perspective on how memories are organized in the brain. Some patients with damage to the temporal lobes have trouble identifying objects such as pictures of animals or vegetables despite the fact that they were able to describe the different shapes that made up those objects (i.e., they could still see). The fact that these deficits were for particular *categories* of objects was intriguing, as it suggested that damaging certain parts of the brain could impair the ability to recognize some categories while leaving others unaffected (Warrington & McCarthy, 1983; Warrington & Shallice, 1979). Because these problems were isolated to certain categories, these patients were diagnosed as having a disorder known as *category specific visual agnosia* (or *CSVA*).

Early attempts to find a pattern in these patients' deficits focused on the distinction between living and non-living categories (see Figure 8.6). Several patients with CSVA had difficulties identifying fruits, vegetables, and/or animals but were still able to accurately identify members of categories such as tools and furniture (Arguin et al., 1996; Bunn et al., 1998). However, although CSVA has been observed in a number of patients, researchers also noted that it would be physically impossible for our brains to have specialized regions for *every* category we have encountered. There simply isn't enough space for this to occur. Instead, they proposed that evolutionary pressures led to the development of specialized circuits in the brain for a *small group of categories* that were

important for our survival. These categories included animals, fruits and vegetables, members of our own species, and possibly tools (Caramazza & Mahon, 2003). Few, if any, other categories involve such specialized memory storage. This theory can explain most, but not all, of the problems observed in the patients tested thus far. It is also in agreement with brain imaging studies showing that different parts of the temporal lobes are active when people view items from different categories, including animals, tools, and people (Martin et al., 1996). Thus, although different people will vary in terms of the exact location that these categories are stored, it does appear that some categories are stored separately from others.

Figure 8.6 Naming Errors for a CSVA Patient



Patients with CSVA have problems identifying members of specific categories. When asked to identify the object depicted by different line drawings, patient E.W. showed a marked impairment for the recognition of animals. Her ability to name items from other categories demonstrated that her overall perceptual abilities were preserved.

Source: Based on data from Caramazza, A., & Mahon, B. Z. (2003). The organization of conceptual knowledge: the evidence from category-specific semantic deficits. *Trends in Cognitive Sciences*, *7*(8), 354–361.

Culture and Categories

Listen to the Audio

Animals, plants, family life, the weather—all of these aspects of daily life fall into categories. Our natural inclination to organize these objects and events into categories is to some degree a universal quality. All around the world, cultures tend to recognize the same objects as plants, animals, dwellings, and so on; we even share basic-level concepts in these categories (Bailenson et al., 2002; Berlin, 1974). On the other hand, the way we categorize objects depends to a some extent on what we have learned about those objects from others in our culture. For example, in North America, cows are sometimes referred to as "livestock." meaning they are animals raised to become food; whereas in India, where cows are regarded as sacred, such a category would be nonsense.

One of the best known relationships between culture and categorization is found in the study of *folk biology*—the ways people in various communities and cultures think about the natural world in their daily lives. All over the world, children seem to recognize early on that plants and animals are two main categories of living things. Next they learn the words for various life forms, such as *tree* or *flower* in the category of plants, or *bird* and *fish* in the category of animals. Although we eventually learn more and more specific names—a single object may be called an animal, mammal, deer, whitetail deer, or northern whitetail deer—most of us will continue to say "deer" and treat it as a basic level category. But this is where culture comes in. In one experiment, researchers found that university students in Michigan referred to animals at the expected level

(e.g., deer instead of whitetail deer). Researchers also travelled to a Mayan village, where there is much less dependence on technology and commercial products; in other words, plants and animals were much more salient to members of that community than to the students in Michigan. The Mayan volunteers tended to shift the basic level to a more specific level, and to be much more aware of varieties at the most specific levels (Atran et al., 1997). Thus, folk biology categories are surprisingly similar around the world, but the use of the basic level of a category is based—at least to some extent—on cultural learning. Psychologists have also discovered that cultural factors influence not just how we categorize individual objects, but also how objects in our world relate to one another.

In addition, how objects are *related* to each other differs considerably across cultures. Which of the two photos in Figure 8.7a do you think someone from North America took? Researchers asked university students in the United States and Japan to take a picture of someone, from whatever angle or degree of focus they chose. In the United States, students were more likely to take close-up pictures, whereas Japanese students typically included surrounding objects (Nisbett & Masuda, 2003). When asked which two objects go together in Figure 8.7b, Japanese students coupled cows with grass, because grass is what cows eat. In the United States, however, students tended to group cows with chickens, because both are animals (Gutchess et al., 2010; Nisbett & Masuda, 2003). These examples demonstrate cross-cultural differences in perceiving how objects are related to their environments. People raised in North America tend to focus on a single characteristic, whereas Japanese people tend to view objects in relation to their environment.

Figure 8.7 Your Culture and Your Point of View

(a)

(b)

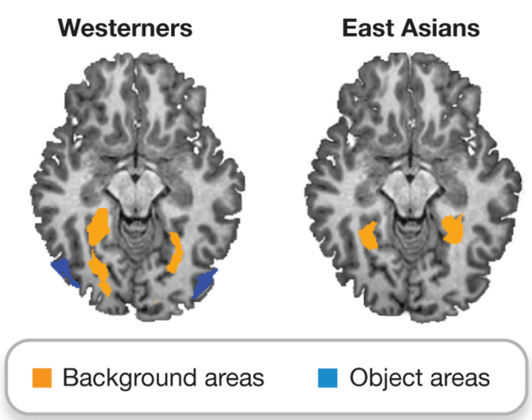
(a) Which of these two pictures do you think a North American would be more likely to take? (b) Which two go together?

Source: (bottom) Adapted from Nisbett, R. E., & Masuda, T. (2003). Culture and point of view. *Proceedings of the National Academy of Sciences, 100*(19), 11163–11170. Copyright © 2003. Reprinted by permission of National Academy of Sciences; (top photos) Blend Images/Shutterstock.

Researchers have even found differences in brain function when people of different cultural backgrounds view and categorize objects (Park & Huang, 2010). Figure 8.8 reveals differences in brain activity when Westerners and East Asians view photos of objects, such as an animal, against a background of grass and trees. Areas of the brain devoted to processing both objects (lateral parts of the occipital lobes) and background (the parahippocampal gyrus, an area underneath the hippocampus) become activated when Westerners view these photos,

whereas only areas devoted to background processes become activated in East Asians (Goh et al., 2007).

Figure 8.8 Brain Activity Varies by Culture



Brain regions that are involved in object recognition and processing are activated differently in people from Western and Eastern cultures. Brain regions that are involved in processing individual objects are more highly activated when Westerners view focal objects against background scenery, whereas people from East Asian countries appear to attend to background scenery more closely than focal objects.

Although culture and memory both clearly affect how we describe and categorize our world, we do need to remember to critically analyze the results of these studies. Specifically, as our world becomes more Westernized, it is possible—even likely—that these cultural differences will decrease. These results, then, tell us about cultural differences *at a given time*. As you saw in the Myths in Mind feature, we should also exercise caution when reading about another form of cultural influences on categorization—linguistic relativity.

Myths in Mind

How Many Words for Snow?

Cultural differences in how people think and categorize items have led to the idea of **linguistic relativity** (or the Whorfian hypothesis)—*the theory that the language we use determines how we understand (and categorize) the world*. One often-cited example is about the Inuit in Canada's Arctic regions, who are thought to have many words for snow, each with a different meaning. For example, *aput* means snow that is on the ground, and *gana* means falling snow. This observation, which was made in the early 19th century by anthropologist Franz Boas, was often repeated and exaggerated, with claims that Inuit people had dozens of words for different types of snow. With so many words for snow, it was thought that perhaps the Inuit people perceive snow differently than someone who does not live near it almost year-round. Scholars used the example to argue that language determines how people categorize the world.

Research tells us that we must be careful in over- generalizing the influence of language on categorization. The reality is that the Inuit seem to categorize snow the same way a person from the rest of Canada does. Someone from balmy Winnipeg can tell the difference between falling snow, blowing snow, sticky snow, drifting snow, and "oh-sweet-God-it's-snowing- in-May" snow, just as well as an Inuit who lives with snow for most of the year (Martin, 1986). Therefore, we see that the linguistic relativity hypothesis is incorrect in this case: The differences in vocabulary for snow does not lead to differences in perception.

Module 8.1 Summary

Listen to the Audio

8.1a Know . . . the key terminology associated with concepts and categories.

Review Module 8.1

Start Over Swap

0/9 REVIEWED · 0 MASTERED

exemplar

Previous Next Got It!

8.1b Understand . . . theories of how people organize their knowledge about the world.

Certain objects and events are more likely to be associated in clusters. The priming effect demonstrates this phenomenon; for example, hearing

the word *fruit* makes it more likely that you will think of *apple* than, say, *table*." More specifically, we organize our knowledge about the world through semantic networks, which arrange categories from general to specific levels. Usually we think in terms of basic-level categories, but under some circumstances we can be either more or less specific. Studies of people with brain damage suggest that the neural representations of members of evolutionarily important categories are stored together in the brain. These studies also show us that our previous experience with a category can influence how we categorize and store new stimuli in the brain.

8.1c Understand . . . how experience and culture can shape the way we organize our knowledge.

One of many possible examples of this influence was discussed. Specifically, ideas of how objects relate to one another differ between people from North America and people from Eastern Asia. People from North America (and Westerners in general) tend to focus on individual, focal objects in a scene, whereas people from Japan tend to focus on how objects are interrelated.

8.1d Apply . . . your knowledge to identify prototypical examples.

Apply Activity

Try the following questions for practice.

1. What do you consider to be a prototypical sport? Why?
2. Some categories are created spontaneously, yet still have prototypes. For example, what might be a prototypical object for the category "what to save if your house is on fire"?

8.1e Analyze . . . the claim that the language we speak determines how we think.

Researchers have shown that language can influence the way we think, but it cannot entirely shape how we perceive the world. For example, people can perceive visual and tactile differences between different types of snow even if they don't have unique words for each type.

Module 8.2 Problem Solving, Judgment, and Decision Making

Listen to the Audio

Learning Objectives

8.2a Know . . . the key terminology of problem solving and decision making.

8.2b Understand . . . the characteristics that problems have in common.

8.2c Understand . . . how obstacles to problem solving are often self-imposed.

8.2d Apply . . . your knowledge to determine if you tend to be a maximizer or a satisficer.

8.2e Analyze . . . whether human thought is primarily logical or intuitive.

Roommates Kurt and Antoine had just started university and decided to spend their fall break on a camping trip. Coming from Germany, Kurt was not able to bring much to school with him, and he wound up spending two weeks visiting nearly a dozen outdoors stores and online retailers, and reading product reviews until late in the night. He wound up spending an astonishing amount of money on a sleeping bag and tent—more than many students will spend on recreation all year. Antoine also needed gear, but he simply went to a sporting goods store and picked up something affordable off the shelf. That first night at the campsite, Kurt mocked Antoine's plain, amateurish equipment. However, by the end of the trip, it was clear that despite unequal equipment, they had equal amounts of fun. If anything, Antoine seemed happier with his purchases as Kurt was expecting so much more. It would seem that one of the greatest benefits of living in a highly technological, consumer-based society is the luxury of choice. However, psychological science has shown that for some people and in some situations, the luxury of choice might actually be better described as a burden. Barry Schwartz and his colleagues (2002)have found in the laboratory what Antoine noticed at the campsite: Individuals who regularly strive for perfection in their decisions—"maximizers," as they are called—are often less satisfied than the "satisficers," who are happy with whatever works.

In other modules of this text, you have read about how we learn and remember new information (Modules 7.1 and 7.2) and how we organize our knowledge of different concepts (Module 8.1). This

module will focus on how we *use* this information to help us solve problems and make decisions. Although it may seem like such “higher-order cognitive abilities” are distinct from memory and categorization, they are actually a wonderful example of how the different topics within the field of psychology relate to each other. When we try to solve a problem or decide between alternatives, we are actually drawing on our knowledge of different concepts and using that information to try to imagine different possible outcomes (Green et al., 2006). How well we perform these tasks depends on a number of factors, including our problem-solving strategies and the type of information available to us.

Defining and Solving Problems

Listen to the Audio

You are certainly familiar with the general concept of a problem, but in psychological terminology, **problem solving** means *accomplishing a goal when the solution or the path to the solution is not clear* (Leighton & Sternberg, 2003; Robertson, 2001). Indeed, many of the problems that we face in life contain *obstacles* that interfere with our ability to reach our goals. The challenge, then, is to find a technique or strategy that will allow us to overcome these obstacles. As you will see, there are a number of options that people use for this purpose—although none of them are perfect.

Problem-Solving Strategies and Techniques

Listen to the Audio

Each of us will face an incredible number of problems in our lives. Some of these problems will be straightforward and easy to solve; however, others will be quite complex and will require us to come up with a novel solution. How do we remember the strategies we can use for routine problems? And, how do we develop new strategies for nonroutine problems? Although these questions *appear* as if they could have an infinite number of answers, there seem to be two common techniques that we use time and again.

One type of strategy is more objective, logical, and slower, whereas the other is more subjective, intuitive, and quicker (Gilovich & Griffin, 2002; Holyoak & Morrison, 2005). The difference between them can be illustrated with an example. Suppose you are trying to figure out where you have left your phone. You've tried having a friend call you from their phone, but you couldn't hear yours ringing anywhere. So, it's not in your house. A *logical* approach might involve making of list of the places you've been in the past 24 hours and then retracing your steps until you (hopefully) find your phone. An *intuitive* approach might involve thinking about previous times you've lost your phone or wallet and using these experiences to guide your search (e.g., "I'm always forgetting my phone at Reyna's place, so I should look there first").

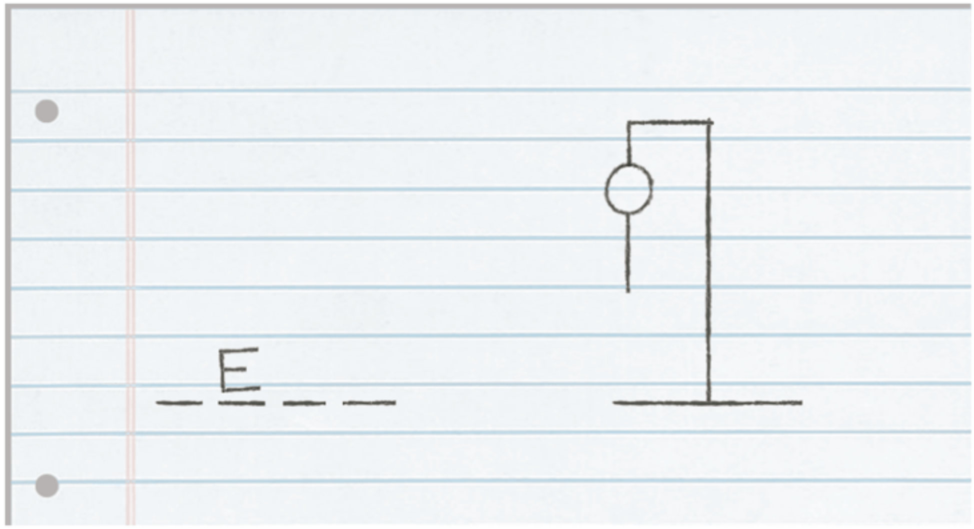
When we think logically, we rely on **algorithms**, *problem-solving strategies based on a series of rules*. As such, they are very logical and follow

a set of steps, usually in a pre-set order. Computers are very good at using algorithms because they can follow a preprogrammed set of steps and perform thousands of operations every second. People, however, are not always so rule-bound. We tend to rely on intuition to find strategies and solutions that seem like a good fit for the problem. These are called **heuristics**, *problem-solving strategies that stem from prior experiences and provide an educated guess as to what is the most likely solution*. Heuristics are often quite efficient; these "rules of thumb" are usually accurate and allow us to find solutions and to make decisions quickly. In the example of trying to figure out where you left your phone, you are more likely to put your phone down at a friend's house than on the bus, so that increases the likelihood that your phone is still sitting on his coffee table. Borrowing your friend's phone to call Reyna is much simpler than retracing your steps from class to the gym to the grocery store, and so on.

The overall goal of both algorithms and heuristics is to find an accurate solution as efficiently as possible. In many situations, heuristics allow us to solve problems quite rapidly. However, the trade-off is that these shortcuts can occasionally lead to incorrect solutions, a topic we will return to later in this module.

Of course, different problems call for different approaches. In fact, in some cases, it might be useful to start off with one type of problem solving and then switch to another. Think about how you might play the children's word game known as hangman, shown in Figure 8.9. Here, the goal state is to spell a word. In the initial state, you have none of the letters or other clues to guide you. So, your obstacles are to overcome (i.e., fill in) blanks without guessing the wrong letters. How would you go about achieving this goal?

Figure 8.9 Problem Solving in Hangman



In a game of Hangman, your job is to guess the letters in the word represented by the four blanks to the left. If you get a letter right, your opponent will put it in the correct blank. If you guess an incorrect letter, your opponent will draw a body part on the stick figure. The goal is to guess the word before the entire body is drawn.

On one hand, an algorithm might go like this: Guess the letter *A*, then *B*, then*C*, and so on through the alphabet until you lose or until the word is spelled. However, this would not be a very successful approach. An alternative algorithm would be to find out how frequently each letter occurs in the alphabet and then guess the letters in that order until the game ends with you winning or losing. So, you would start out by selecting *E*, then *A*, and so on. On the other hand, a heuristic might be useful. For example, if you discover the last letter is *G*, you might guess that the next-to-last letter is *N*, because you know that many words end with -*ing*. Using a heuristic here would save you time and usually lead to an accurate solution more quickly than an algorithmic approach.

As you can see, some problems (such as the hangman game) can be approached with either algorithms or heuristics. In other words, most people start out a game like hangman with an algorithm: Guess the most frequent letters until a recognizable pattern emerges, such as -*ing*, or the

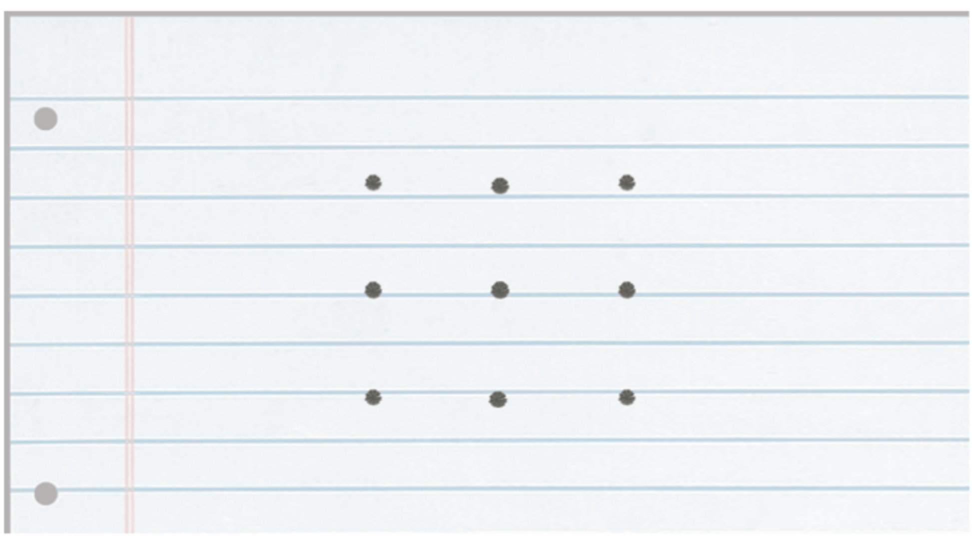
letters -*oug* (which are often followed by *h*, as in *tough* or *cough*) appear. At that point, you might switch to heuristics and guess which letters would be most likely to fit in the spaces.

Cognitive Obstacles

Listen to the Audio

Using algorithms or heuristics will often allow you to eventually solve a problem; however, there are times when the problem-solving rules and strategies that you have established might actually get in the way of problem solving. The nine-dot problem (Figure 8.10; Maier, 1930) is a good example of such a *cognitive obstacle*. The goal of this problem is to connect all nine dots using only four straight lines and without lifting your pen or pencil off the paper. Try solving the nine-dot problem before you read further.

Figure 8.10 The Nine-Dot Problem

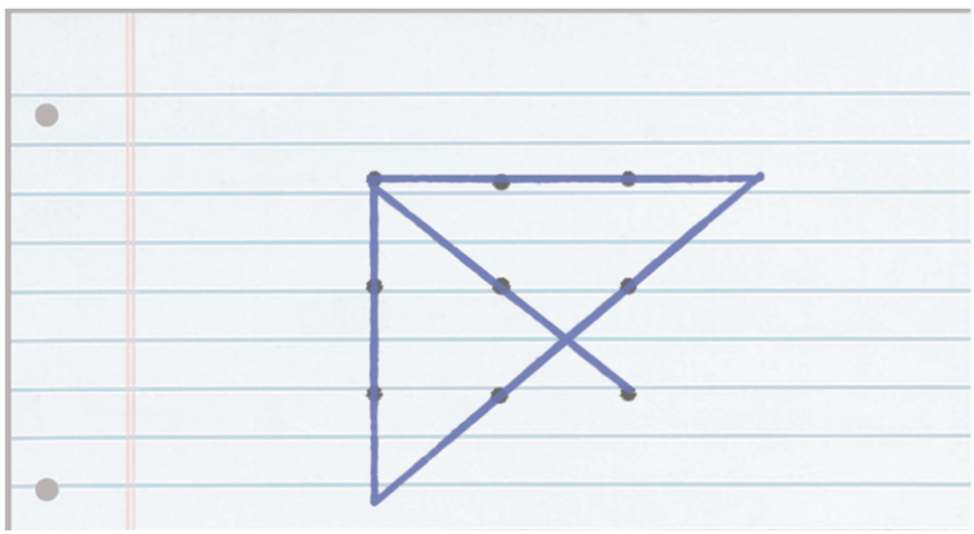


Connect all nine dots using only four straight lines and without lifting your pen or pencil (Maier, 1930). The solution to the problem can be seen in Figure 8.11.

Source: Maier, N. F. (1930). Reasoning in humans. I. On direction. *Journal of Comparative Psychology*, *10*(2), 115–143. American Psychological Association.

Here is something to think about when solving this problem: Most people impose limitations on where the lines can go, even though those limits are not a part of the rules. Specifically, people often assume that a line cannot extend beyond the dots. As you can see in Figure 8.11, breaking these rules is necessary in order to find a solution to the problem.

Figure 8.11 One Solution to the Nine-Dot Problem



In this case, the tendency is to see the outer edge of dots as a boundary, and to assume that one cannot go past that boundary. However, if you are willing to extend some of the lines beyond the dots, it is actually quite a simple puzzle to complete.

Having a routine solution available for a problem generally allows us to solve that problem with less effort than we would use if we encountered it for the first time. This efficiency saves us time and effort. Sometimes, however, routines may impose cognitive barriers that impede solving a problem if circumstances change so that the routine solution no longer works. A **mental set** *is a cognitive obstacle that occurs when an individual*

attempts to apply a routine solution to what is actually a new type of problem. Figure 8.12 presents a problem that often elicits a mental set. The answer appears at the bottom of the figure, but make your guess before you check it. Did you get it right? If not, then you probably succumbed to a mental set.

Figure 8.12 The Five-Daughter Problem

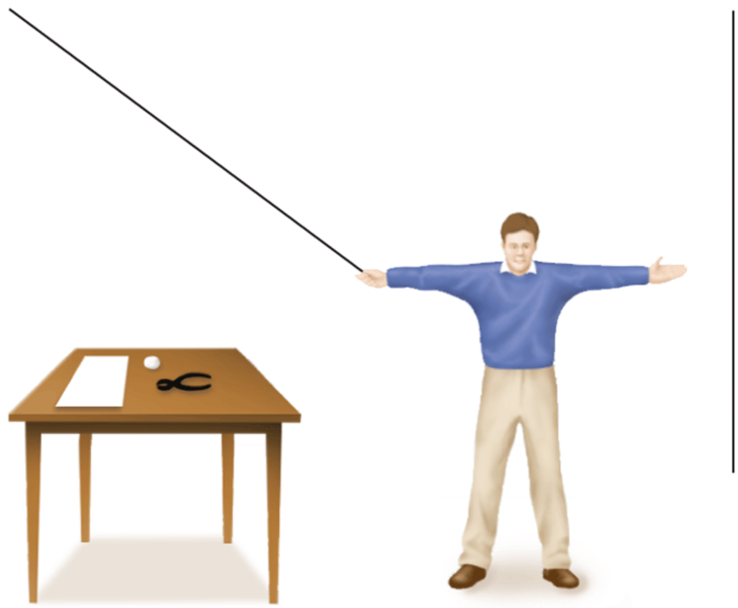
Maria's father has five daughters: Lala, Lela, Lila, and Lola. What is the fifth daughter's name?

The fifth daughter's name is Maria.

Mental sets can occur in many different situations. For instance, a person may experience **functional fixedness**, *which occurs when an individual identifies an object or technique that could potentially solve a problem, but can think of only its most obvious function*. Functional fixedness can be illustrated with a classic thought problem: Figure 8.13 shows two strings hanging from a ceiling. Imagine you are asked to tie the strings together. However, once you grab a string, you cannot let go of it until both are tied together. The problem is, unless you have extraordinarily long arms, you cannot reach the second string while you are holding on to the first one (Maier, 1931). So how would you solve the problem? Figure 8.16

offers one possible answer and an explanation of what makes this problem challenging.

Figure 8.13 The Two-String Problem



Imagine you are standing between two strings and need to tie them together. The only problem is that you cannot reach both strings at the same time (Maier, 1931). In the room with you is a table, a piece of paper, a pair of pliers, and a ball of cotton. What do you do? For a solution, see Figure 8.16.

Problem solving occurs in every aspect of life, but as you can see, there are basic cognitive processes that appear no matter what the context. We identify the goal we want to achieve, try to determine the best strategy to do so, and hope that we do not get caught by unexpected obstacles—especially those we create in our own minds.

Of course, not all problems are negative obstacles that must be overcome. Problem solving can also be part of some positive events as well.

Psych@

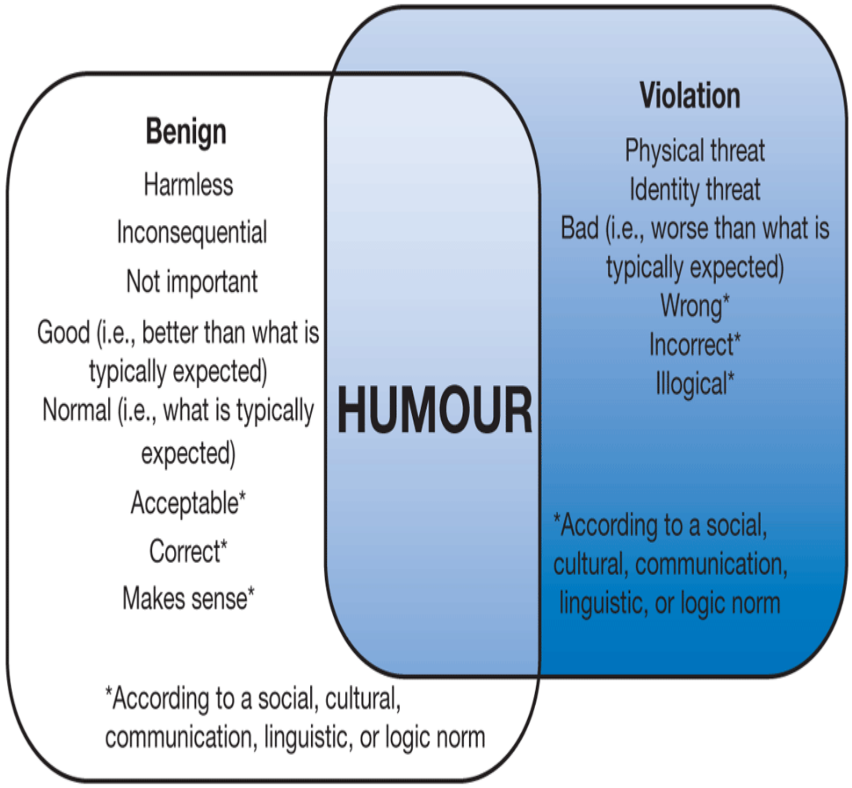
Problem Solving and Humour

Question: Why can't university students take exams at the zoo?

Answer: There are too many cheetahs.

Jokes are actually problems that need to be solved in order to get a laugh. According to *Benign Violation* theory, the solution typically requires three elements The first requires the audience to detect incongruity between the set up and punchline—this is a *violation* of expectations: What on earth do large, spotted cats have to do with exams? This violation is the problem; it creates an initial, psychological tension. The second element is to *resolve* the violation: "cheetahs" sounds a lot like "cheaters," which is a concept very much related to university exams. At this point, the audience has solved the problem. But is it funny? Resolving a surprising violation is only funny if it is *benign*. In other words, it's funny only if no harm is done (see Figure 8.14; Warren & McGraw, 2015).

Figure 8.14 The Benign Violation Theory of Humour



Humour is a form of problem solving. Most things we find funny begin with a problem: a *violation* of our expectations. The humour comes from resolving that violation, but only if the solution is *benign*. These processes lead to a feeling of amusement and laughter or, in the case of the cheetah joke, a groan and rolling of the eyes.

Source: Warren, C., & McGraw, A. P. (2016). Differentiating what is humorous from what is not. *Journal of Personality and Social Psychology, 110*(3), 407-430.

Benign violation theory can also explain what we find humorous outside of jokes. For example, watching a friend falling down the stairs may present a type of violation: That's not how he is expected to get downstairs. However, it isn't funny if he is seriously injured—then you resolve the violation with alarm and concern. It's only funny if it's benign. In other words, he's physically okay—although his pride is a little hurt—so you can start to poke fun at him (McGraw et al., 2012).

Benign violation theory shows us that humour actually arises from solving a problem—a discrepancy between what is expected and what actually happens. Unfortunately, thinking too much about a joke can be a bad thing. Author E.B. White once likened dissecting a joke to dissecting a frog: Nobody enjoys it and the frog winds up dead.

Recent neuroimaging studies have manipulated the characteristics of verbal stimuli to allow the researchers to identify brain areas related to nonsense stimuli (incongruity that was not resolved) and stimuli that *were* perceived as humorous (incongruities that were successfully resolved). Incongruity detection and resolution activated areas in the temporal lobes and the medial frontal lobes (close to the middle of the brain). Elaboration activated a network involving the left frontal and parietal lobes (Chan et al., 2013). The purpose of this section wasn't to take the joy out of humour. Instead, it was to show that humour, like most of our behaviours, involves the biopsychosocial model. If we suggested otherwise, we'd be lion.

Judgment and Decision Making

Listen to the Audio

Like problem solving, judgments and decisions can be based on logical algorithms, intuitive heuristics, or a combination of the two types of thought (Gilovich & Griffin, 2002; Holyoak & Morrison, 2005). We tend to use heuristics more often than we realize, even those of us who consider ourselves to be logical thinkers. This isn't necessarily a bad thing—heuristics allow us to make efficient judgments and decisions all the time. In this section of the module, we will examine specific types of heuristics, how they positively influence our decision making, and how they can *sometimes* lead us to incorrect conclusions.

Conjunction Fallacies and Representativeness

Listen to the Audio

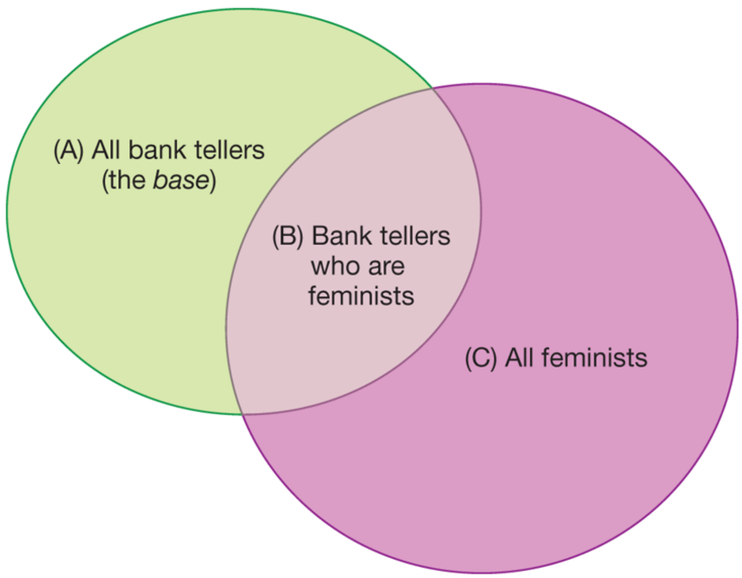
> *Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in antinuclear demonstrations. Which is more likely?*
>
> **A.** *Linda is a bank teller.*
> **B.** *Linda is a bank teller and is active in the feminist movement.*

Which answer did you choose? In a study that presented this problem to participants, the researchers reported that (B) was chosen more than 80% of the time. Most respondents stated that option (B) seemed more correct even though option (A) is actually much more likely and would be the correct choice based on the question asked (Tversky & Kahneman, 1982).

So how is the correct answer (A)? Individuals who approach this problem from the stance of probability theory would apply some simple logical steps. The world has a certain number of (A) bank tellers; this number would be considered the *base rate*, or the rate at which you would find a bank teller in the world's population just by asking random people on the street if they are a bank teller. Among the base group, there will be a certain number of (B) bank tellers who are feminists, as shown in Figure 8.15. In other words, the number of bank tellers who are feminists will always be a fraction of (i.e., less than) the total number of bank tellers. But because many of Linda's qualities could relate to a "feminist," the idea that Linda is a bank teller *and* a feminist feels correct. This type of error, known as the **conjunction fallacy**, *reflects the mistaken belief that finding a*

specific member in two overlapping categories (i.e., a member of the conjunction *of two categories) is more likely than finding any member of one of the larger, general categories*.

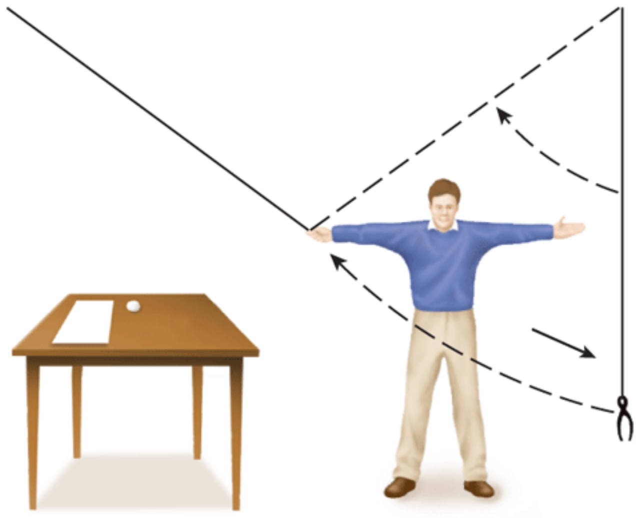
Figure 8.15 The Conjunction Fallacy



There are more bank tellers in the world than there are bank tellers who are feminists, so there is a greater chance that Linda comes from either (A) or (B) than just (B) alone.

The conjunction fallacy demonstrates the use of the **representativeness heuristic**: *making judgments of likelihood based on how well an example represents a specific category*. In the bank teller example, we cannot identify any traits that seem like a typical bank teller. At the same time, the traits of social activism really do seem to represent a feminist. Thus, the judgment was biased by the fact that Linda seemed representative of a feminist, even though a feminist bank teller will always be rarer than bank tellers in general (i.e., the representativeness heuristic influenced the decision more than logic or mathematical probabilities).

Figure 8.16 A Solution to the Two-String Problem



One solution to the two-string problem from Figure 8.13 is to take the pliers off the table and tie them to one string. This provides enough weight to swing one string back and forth while you grab the other. Many people demonstrate functional fixedness when they approach this problem—they do not think of using the pliers as a weight because its normal function is as a grasping tool.

Seeing this type of problem has led many people to question what is wrong with people's ability to use logic: Why is it so easy to get 80% of the people in a study to give the wrong answer? In fact, there is nothing inherently *wrong* with using heuristics; they simply allow individuals to obtain quick answers based on readily available information. In fact, heuristics often lead to correct assumptions about a situation.

Consider this scenario:

> *You are in a department store trying to find a product that is apparently sold out. At the end of the aisle, you see a young man in tan pants with a red polo shirt—the typical employee's uniform of this chain of stores. Should you stop and consider the probabilities that might explain his attire?*
>
> **A.** *A young man of this age would wear tan pants and a red polo shirt.*
> **B.** *A young man of this age would wear tan pants and a red polo shirt and work at this store.*

Or does it make sense to just assume (B) is correct, and to simply ask the young man for help (Shepperd & Koch, 2005)? In this case, it would make perfect sense to assume (B) is correct and not spend time wondering about the best logical way to approach the situation. In other words, heuristics often work and, in the process, save us time and effort. However, there are many situations in which these mental shortcuts can lead to biased or incorrect conclusions.

Representativeness Heuristic and Conspiracy Theories

Introduction

Conspiracy theories often develop after major geopolitical events, such as the assassination of President John F. Kennedy or the attacks of 9/11. Individuals who are intrigued by such theories are more likely to see conspiracies in more local events as well, especially unusual events that tend to make unusual explanations seem more likely. Consider the following examples from a recent study.

Case #1: Patrick

Case #2: Josh

The Key Responses

The Role of Representativeness

The Availability Heuristic

Listen to the Audio

The **availability heuristic** *entails estimating the frequency of an event based on how easily examples of it come to mind*. In other words, we assume that if examples are readily *available*, then they must be very frequent. For example, researchers asked volunteers which was more frequent in the English language:

A. Words that begin with the letter *K*
B. Words that have *K* as the third letter

Most subjects chose (A) even though it is not the correct choice. The same thing happened with the consonants *L*, *N*, *R*, and *V*, all of which appear as the third letter in a word more often than they appear as the first letter (Tversky & Kahneman, 1973). This outcome reflects the application of the availability heuristic: People base judgments on the information most readily available.

Of course, heuristics often do produce correct answers. Subjects in the same study were asked which was more common in English:

A. Words that begin with the letter *K*
B. Words that begin with the letter *T*

In this case, more subjects found that words beginning with *T* were readily available to memory, and they were correct. The heuristic helped

provide a quick, intuitive answer.

There are numerous real-world examples of the availability heuristic. In the year following the September 11, 2001, terrorist attacks, people were much more likely to overestimate the likelihood that planes could crash and/or be hijacked. As a result, fewer people flew that year than in the year prior to the attacks, opting instead to travel by car when possible. The availability of the image of planes crashing into the World Trade Center was so vivid and easily retrieved from memory that it influenced decision making. Ironically, this shift proved to be dangerous, particularly given that driving is statistically *much* more dangerous than flying. Gerd Gigerenzer, a German psychologist at the Max Planck Institute in Berlin, examined traffic fatalities on U.S. roads in the years before and after 2001. He found that in the calendar year following these terrorist attacks, there were more than 1500 additional deaths on American roads (when compared to the average of the previous years). Within a year of the attacks, the number of people using planes returned to approximately pre-9/11 levels; so did the number of road fatalities (Gigerenzer, 2004). In other words, for almost a year, people overestimated the risks of flying because it was easier to think of examples of 9/11 than to think of all of the times hijackings and plane crashes did *not* occur; and they underestimated the risks associated with driving because these images were less available to many people. This example shows us that heuristics, although often useful, can cause us to incorrectly judge the risks associated with many elements of our lives (Gardner, 2008).

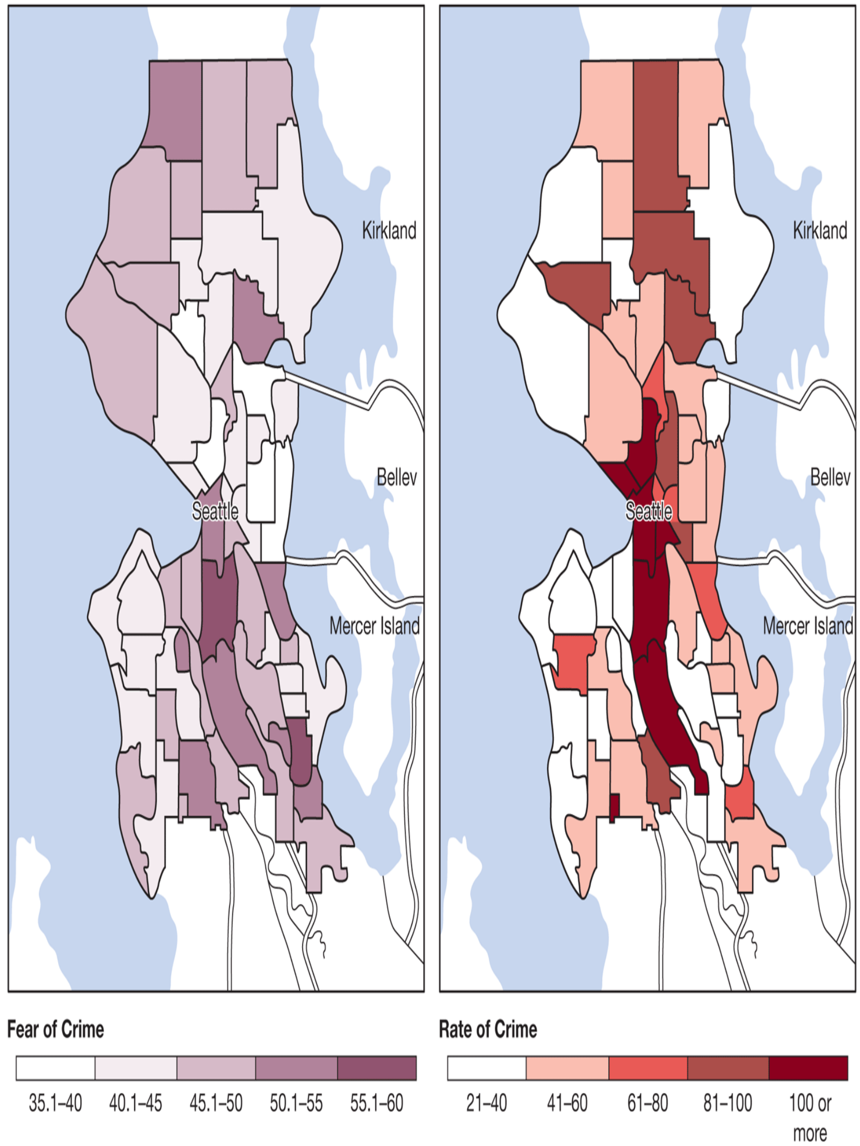
#Psych

The World Might Not Be As Mean As You Think

The more time you spend online, the more you will encounter news, commentary on social media, and re-posted stories of violence and mayhem in the world. The result of this exposure may result in what some social scientists have called the *mean world syndrome*. Although it sounds a little bit like a diagnosis, it is far from being a disorder. In fact, it is a typical outcome of the availability heuristic: Increased exposure to crime and terrorism online results in readily available examples. When thinking about violence, those images and stories come to mind quickly; they are more readily *available* than the positive stories. Therefore, people who have recently scrolled through a major news website checking out the headlines are likely to estimate violence as being more prevalent than the data show.

To illustrate this point, a journalist in Seattle, Washington, compared the results of a public opinion poll (On a scale from 0 to 100, how much do you worry about crime in your neighbourhood?) to the actual crime data gathered by the city's police department (See Figure 8.17). The average citizen's rating was 45 points. Yet a neighbourhood-by-neighbourhood comparison showed that residents of South Beacon Hill, the safest neighbourhood, produced the 12th highest fear score of 49.8. Similar findings came from residents of the Brighton/Dunlap and Pigeon Point neighbourhoods. Although they are among the 15 safest neighbourhoods, their fear averages were the 2nd and 3rd highest in the survey (Balk, 2018).

Figure 8.17 Fear of Crime vs. Rate of Crime



These findings may be surprising to some, but to psychologists familiar with availability, they are relatively easy to explain. For residents in the safest neighbourhoods, reports of crime are likely to be more shocking and emotional because they are infrequent. It is this emotional content that makes those stories available and, as a consequence, the citizens are likely to see the world as a much meaner place than it really is.

Anchoring and Framing Effects

Listen to the Audio

While the representativeness and availability heuristics involve our ability to remember examples that are similar to the current situation, other heuristics influence our responses based on the way that information is presented. Issues such as the wording of a problem and the problem's frames of reference can have a profound impact on judgments. One such effect, known as the **anchoring effect**, *occurs when an individual attempts to solve a problem involving numbers and uses previous knowledge to keep (i.e.,* anchor*) the response within a limited range*. Sometimes this previous knowledge consists of facts that we can retrieve from memory. For example, imagine that you are asked to name the year that British Columbia became part of Canada. Although most of you would, of course, excitedly jump from your chair and shout, "1871!" the rest might assume that if Canada became a country in 1867, then British Columbia likely joined a few years after that. In this latter case, the birth of our country in 1867 served as an anchor for the judgment about when British Columbia joined Confederation.

The anchoring heuristic has also been produced experimentally. In these cases, questions worded in different ways can produce vastly different responses (Epley & Gilovich, 2006; Kahneman & Miller, 1986). For example, consider what might happen if researchers asked the same question to two different groups, using a different anchor each time:

A. What percentage of countries in the United Nations are from Africa? Is it greater than or less than 10%? What do you think the exact percentage is?

B. What percentage of countries in the United Nations are from Africa? Is it greater than or less than 65%? What do you think the exact percentage is?

Researchers conducted a study using similar methods and found that individuals in group (A), who received the 10% anchor, estimated the number to be approximately 25%. Individuals in group (B), who received the 65% anchor, estimated the percentage at approximately 45%. In this case, the anchor obviously had a significant effect on the estimates.

The anchoring heuristic can have a large effect on your life. For example, have you ever had to bargain with someone while travelling? Or have you ever negotiated the price of a car? If you are able to establish a low anchor during bargaining, the final price is likely to be much lower than if you let the salesperson dictate the terms. So don't be passive—use what you learn in this course to save yourself some money.

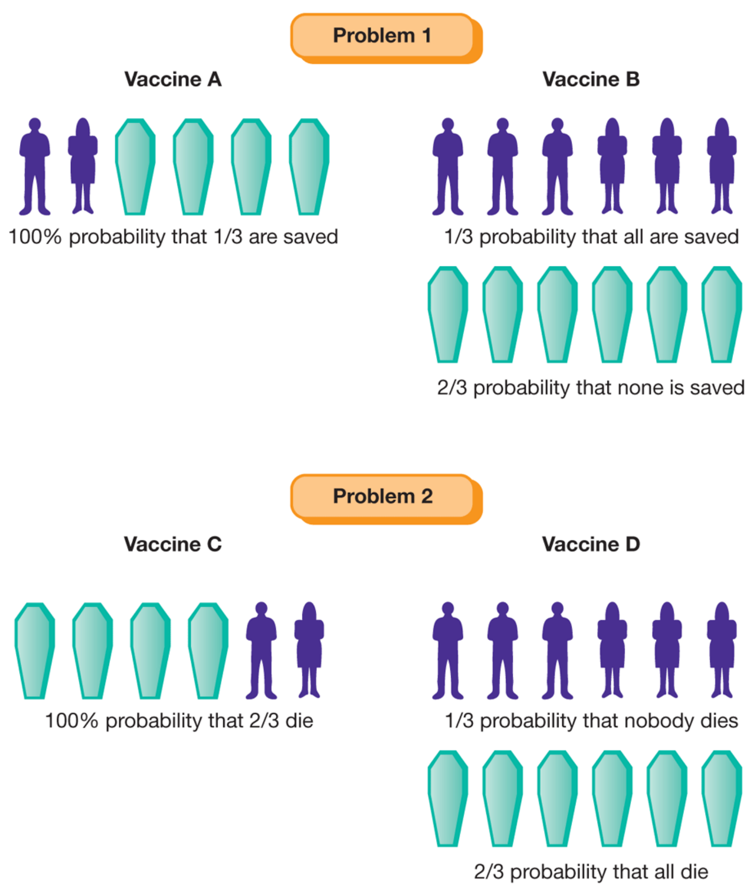
Decision making can also be influenced by how a problem is worded or *framed*. Consider the following dilemma: Imagine that you are a selfless doctor volunteering in a village in a disease-plagued part of the world. You have two treatment options. Vaccine A has been used before; you know that it will save 200 of the 600 villagers. Vaccine B is untested; it has a 33% chance of saving all 600 people and a 67% chance of saving no one. Which option would you choose?

Now let's suppose that you are given two different treatment options for the villagers. Treatment C has been used before and will definitely kill 67% of the villagers. Treatment D is untested; it has a 33% chance of

killing none of the villagers and a 67% chance of killing them all. Which option would you choose?

Most people choose the vaccine that will definitely save 200 people (Vaccine A) and the treatment that has a chance of killing no one (Treatment D). This tendency is interesting because options A and C are identical as are options B and D. As you can see by looking at Figure 8.18, the only difference between them is that one is framed in terms of saving people and the other is framed in terms of killing people. Yet, people become much more risk-averse when the question is framed in terms of potential losses (or deaths).

Figure 8.18 Framing Effects



When people are asked which vaccine or treatment they would use to help a hypothetical group of villagers, the option they select is influenced

by how the question is worded or framed. If the question is worded in terms of saving villagers, most people choose Vaccine A. If the question is worded in terms of killing villagers, most people choose Treatment D.

Source: Wade, C., & Tavris, C. (2002). *Invitation to Psychology*, 2nd ed., ©2002, p. 121. Adapted and electronically reproduced by permission of Pearson Education, Inc., Upper Saddle River, New Jersey.

Belief Perseverance and Confirmation Bias

Listen to the Audio

Whenever we make a decision, solve a problem, or commit ourselves to a cause, we become invested in that idea. We usually have ample opportunity to evaluate that belief with any new evidence or arguments that come along. These are our chances to make sure we got it right and to correct ourselves when the facts prove us wrong. However, we are often more invested in preserving confidence in our beliefs than in getting to the truth.

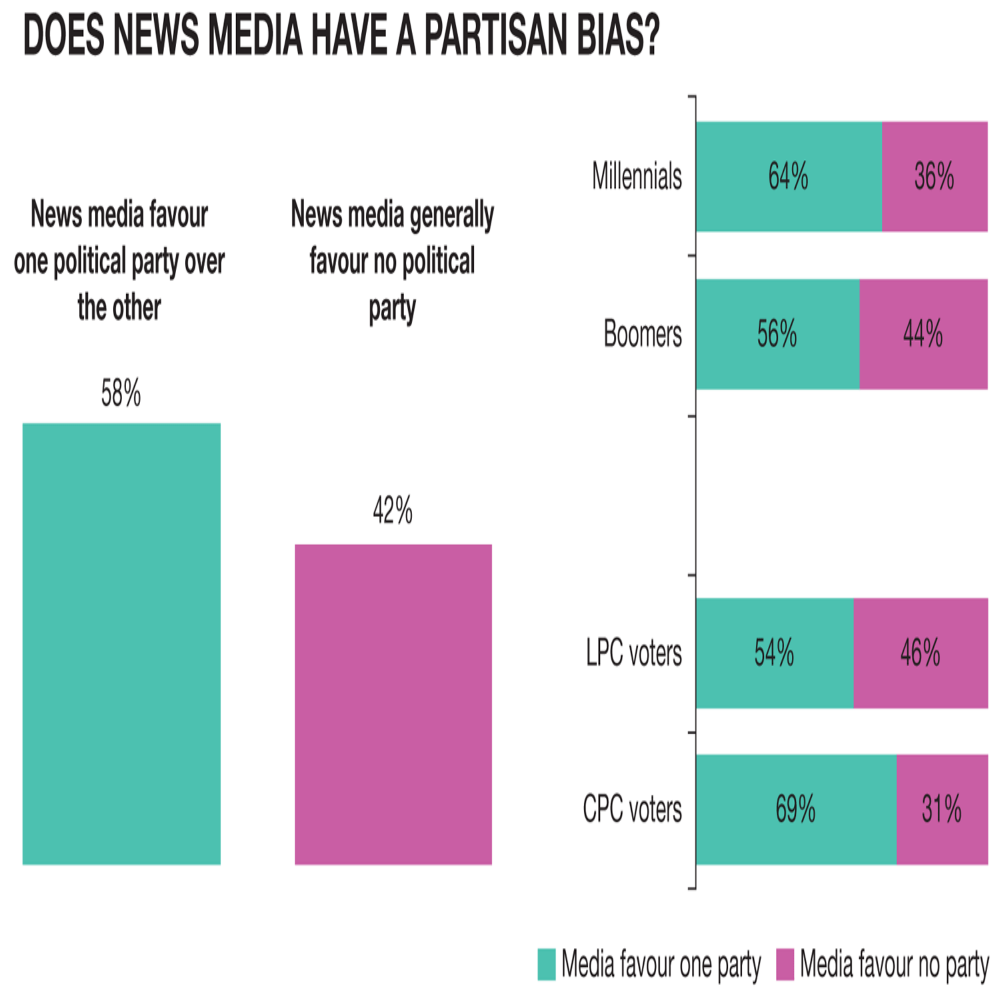
Let's use an example from politics to make this discussion more concrete. (There may be no other aspect of life in which we are more committed to our beliefs, except for perhaps sports teams.) Each time an election comes around, party members tend to get behind their nominee and endorse most of the campaign platform. Although this feels like a genuine, well-informed political judgment to the individual voter, it is easy for psychologists to demonstrate the tricks we play on ourselves to remain steadfast in our beliefs.

One trick, or cognitive bias, is **belief perseverance**, *when an individual remains committed to their decision or belief even in the face of evidence against it*. One group of psychologists in the United States demonstrated this in an interesting experiment conducted during state elections. First, they recruited participants from the two major political parties. Each of the participants read about some questionable election-related activities, such as a group of young adults stealing campaign signs from the opposition

party. What do you think of that activity: Is it stealing or just a fun prank? If we are logical, then our judgment will be the same regardless of party. In reality, however, researchers found is that participants judged the act much more negatively when the culprits (i.e., thieves) were from their opponent party and, in some cases, even justified the act when the culprits (i.e., pranksters) were from the same party affiliation (Classen & Ensley, 2015). By interpreting a generic event to fit their views, the participants were able to preserve their belief in the integrity of their own party, not to mention in the flaws of the opposition.

Belief perseverance occurs when information is presented to a person. A second cognitive bias happens when a person goes out in search for information. This is the **confirmation bias**, *when an individual searches for (or pays attention to) only evidence that will confirm his or her beliefs instead of evidence that might disconfirm them*. To continue our political example, consider how citizens get their news (Figure 8.19): they select from many broadcast, print, and online sources. Around half of Canadian voters believe these mainstream media have a bias (Anderson & Coletto, 2017). To them, it's no surprise when a liberal friend turns on the CBC or a conservative neighbour reads the *National Post*—that is how an individual would seek out confirming information. To a large extent, they would be right. In one experiment, participants were asked to complete a questionnaire about political beliefs and then to browse websites while researchers tracked their activity. Participants spent significantly more time exploring webpages that were consistent with their beliefs, even when those websites were generally believed to be of poorer quality (Westerwick et al., 2017). At least in this study, participants were biased towards confirming their beliefs, not becoming more informed.

Figure 8.19 Canadian News Media and "Fake News"



Slightly more than half of Canadian voters surveyed believe news media outlets have some political bias. However, the numbers are higher among millennials than baby boomers, and among conservative voters versus liberal voters.

Working the Scientific Literacy Model

Maximizing and Satisficing in Complex Decisions

Listen to the Audio

One privilege of living in a technologically advanced, democratic society is that we get to make many decisions for ourselves. However, for each decision there can be more choices than we can possibly consider. As a result, two types of consumers have emerged in our society. *Satisficers* are individuals who seek to make decisions that are, simply put, "good enough." In contrast, *maximizers* are individuals who attempt to evaluate every option for every choice until they find the perfect fit. Most people exhibit some of both behaviours, satisficing at times and maximizing at other times. However, if you consider all the people you know, you can probably identify at least one person who is an extreme maximizer—they will always be comparing products, jobs, classes, and so on, to find out who has made the best decisions. At the same time, you can probably identify an extreme satisficer —the person who will be satisfied with their choices as long as they are "good enough."

What do we know about maximizing and satisficing?

If one person settles for the good-enough option while another searches until they find the best possible option, which individual do you think will be happier with the decision in the end? Most

people believe the maximizer will be happier, but this is not always the case. In fact, researchers such as Barry Schwartz of Swarthmore College and his colleagues have no shortage of data about the *paradox of choice*, the observation that more choices can lead to less satisfaction. In one study, the researchers asked participants to recollect both large (more than $100) and small (less than $10) purchases and report the number of options they considered, the time spent shopping and making the decision, and the overall satisfaction with the purchase. Sure enough, those who ranked high on a test of maximization invested more time and effort, but were actually less pleased with the outcome (Schwartz et al., 2002).

In another study, researchers questioned recent university graduates about their job search process. Believe it or not, maximizers averaged 20% higher salaries, but were less happy about their jobs than satisficers (Iyengar et al., 2006). This outcome occurred even though we would assume that maximizers would be more careful when selecting a job—*if* humans were perfectly logical decision makers.

So, now we know that just the presence of alternative choices can drive down satisfaction—but how can that be?

How can science explain maximizing and satisficing?

To answer this question, researchers asked participants to read vignettes that included a trade-off between number of choices and effort (Dar-Nimrod et al., 2009). Try this example for yourself:

> *Your cleaning supplies (e.g., laundry detergent, rags, carpet cleaner, dish soap, toilet paper, glass cleaner) are running low. You have the option of going to the nearest grocery store (five minutes away) that offers four alternatives for each of the items you need, or you can*

> *drive to the grand cleaning superstore (25 minutes away), which offers 25 alternatives for each of the items (for approximately the same price). Which store would you go to?*

In the actual study, maximizers were much more likely to spend the extra time and effort to have more choices. Thus, if you decided to go to the store with more options, you are probably a maximizer. What this scenario does not tell us is whether having more or fewer choices was pleasurable for either maximizers or satisficers.

See how well you understand the nature of maximizers and satisficers by predicting the results of the next study: Participants at the University of British Columbia completed a taste test of *one* piece of chocolate, but they could choose this piece of chocolate from an array of 6 pieces or an array of 30 pieces. When there were 6 pieces, who was happier—maximizers or satisficers? What happened when there were 30 pieces to choose from? As you can see in Table 8.2, the maximizers were happier when there were fewer options. On a satisfaction scale indicating how much they enjoyed the piece of chocolate they selected, the maximizers scored higher in the 6-piece condition (5.64 out of 7) than in the 30-piece condition (4.73 out of 7; Dar-Nimrod et al., 2009). In contrast, satisficers did not show a statistical difference between the conditions (5.44 and 6.00 for the 6-piece and 30-piece conditions, respectively).

Table 8.2 Satisfaction of Maximizers and Satisficers

Table 8.2 Satisfaction of Maximizers and Satisficers

	6 Alternatives	30 Alternatives	Difference
Maximizers	5.64	4.73	–0.91
Satisficers	5.44	6.00	+0.46

Source: Adapted from Dar-Nimrod et al. (2009). The Maximization Paradox: The costs of seeking alternatives. *Personality and Individual Differences, 46*, 631–635, Figure 1 and Table 1.

Can we critically evaluate this information?

One hypothesis that seeks to explain the dissatisfaction of maximizers suggests that they invest more in the decision, so they expect more from the outcome. Imagine that a satisficer and a maximizer purchase the same digital camera for $175. The maximizer may have invested significantly more time and effort into the decision so, in effect, she *feels like* she paid considerably more for the camera.

Regardless of the explanation, we should keep in mind that maximizers and satisficers are preexisting categories. People cannot be randomly assigned to be in one category or another, so these findings represent the outcomes of quasi- experimental research (see Module 2.2). We cannot be sure that the act of maximizing leads to dissatisfaction based on these data. Perhaps maximizers are the people who are generally less satisfied, which in turn leads to maximizing behaviour.

Why is this relevant?

The research on maximization suggests that there are some aspects of our consumer-based society that might actually be making us less happy. This seems counterintuitive given that the overwhelming number of product options available to us almost guarantees that we will get exactly what we want (or *think* we want). If you have the tendency to maximize during consumer purchases, it may help to think about what you want before you fall into the trap of making dozens of comparisons. Write down your expectations and stop when you find them in one product. Fortunately for maximizers, more recent research shows that you are more likely to plan effectively for the future. This means better career trajectory, savings for retirement, life satisfaction, and better overall sense of well-being over time (Kokkoris, 2016; Zhu et al., 2017). Perhaps an ideal arrangement works like this: Satisficers should help their maximizing friends enjoy the day-to-day activities like picking an entrée from a menu. Maximizers, in turn, can help satisficing friends think about what will happen 10 or 20 years down the road.

Module 8.2 Summary

Listen to the Audio

8.2a Know . . . the key terminology of problem solving and decision making.

Review Module 8.2

Start Over Swap

0/11 REVIEWED · 0 MASTERED

anchoring effect

Previous Next Got It!

8.2b Understand . . . the characteristics that problems have in common.

All problems involve people attempting to reach some sort of goal; this goal can be an observable behaviour like learning to serve a tennis ball or

a cognitive behaviour like learning Canada's 10 provincial capitals. This process involves forming strategies that will allow the person to reach the goal. It may also require a person to overcome one or more obstacles along the way.

8.2c Understand . . . how obstacles to problem solving are often self-imposed.

Many obstacles arise from the individual's mental set, which occurs when a person focuses on only one potential solution and does not consider alternatives. Similarly, functional fixedness can arise when an individual does not consider alternative uses for familiar objects.

8.2d Apply . . . your knowledge to determine if you tend to be a maximizer or a satisficer.

Apply Activity

Rate the following items on a scale from 1 (completely disagree) to 7 (completely agree), with 4 being a neutral response.

1. Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even ones that aren't present at the moment.
2. No matter how satisfied I am with my job, it's only right for me to be on the lookout for better opportunities.
3. When I am in the car listening to the radio, I often check other stations to see whether something better is playing, even if I am relatively satisfied with what I'm listening to.
4. When I watch TV, I channel surf, often scanning through the available options even while attempting to watch one program.
5. I treat relationships like clothing: I expect to try a lot on before finding the perfect fit.

6. I often find it difficult to shop for a gift for a friend.
7. When shopping, I have a difficult time finding clothing that I really love.
8. No matter what I do, I have the highest standards for myself.
9. I find that writing is very difficult, even if it's just writing to a friend, because it's so difficult to word things just right. I often do several drafts of even simple things.
10. I never settle for second best.

When you are finished, average your ratings together to find your overall score. Scores greater than 4 indicate maximizers; scores less than 4 indicate satisficers. Approximately one-third of the population scores below 3.25 and approximately one-third scores above 4.75. Where does your score place you?

8.2e Analyze . . . whether human thought is primarily logical or intuitive.

This module provides ample evidence that humans are not always logical. Heuristics are helpful decision-making and problem-solving tools, but they do not always follow logical principles. Even so, the abundance of heuristics does not mean that humans are never logical; instead, they simply point to the limits of our rationality.

Module 8.3 Language and Communication

Listen to the Audio

Manuela Hartling/Reuters

Learning Objectives

8.3a Know . . . the key terminology from the study of language.

8.3b Understand . . . how language is structured.

8.3c Understand . . . how genes and the brain are involved in language use.

8.3d Apply . . . your knowledge to distinguish between units of language such as phonemes and morphemes.

8.3e Analyze . . . whether species other than humans are able to use language.

Dog owners are known for attributing a lot of intelligence, emotion, and "humanness" to their canine pals. Sometimes they may appear to go overboard—such as Rico's owners, who claimed their border collie understood 200 words, most of which referred to different toys and objects he liked to play with. His owners claimed that they could show Rico a toy, repeat its name a few times, and toss the toy into a pile of other objects; Rico would then retrieve the object upon verbal command. Rico's ability appeared to go well beyond the usual "sit," "stay," "heel," and perhaps a few other words that dog owners expect their companions to understand.

Claims about Rico's language talents soon drew the attention of scientists, who skeptically questioned whether the dog was just responding to cues by the owners, such as their possible looks or gestures toward the object they asked their pet to retrieve. The scientists set up a carefully controlled experiment in which no one present in the room knew the location of the object that was requested. Rico correctly retrieved 37 out of 40 objects. The experimenters then tested the owners' claim that Rico could learn object names in just one trial. Rico again confirmed his owners' claims, and the researchers concluded that his ability to understand new words was comparable to that of a three-year-old child (Kaminski et al., 2004). Following on Rico's heels was

another border collie named Chaser, who mastered over 1000 words (Pilley & Reid, 2011).

However, as you will see in this module, canine abilities, while impressive, are dwarfed by those of humans. Our ability to reorganize words into complex thoughts is unique in the animal kingdom and may even have aided our survival as a species.

Communication happens just about anywhere you can find life. Dogs bark, cats meow, monkeys chatter, and mice can emit sounds undetectable to the human ear when communicating. Honeybees perform an elaborate dance to communicate the direction, distance, and quality of food sources (von Frisch, 1967). Animals even communicate by marking their territories with their distinct scent, much to the chagrin of the world's fire hydrants. Language is among the ways that humans communicate. It is quite unlike the examples of animal communication mentioned previously. So what differentiates language from these other forms of communication? And what is it about our brains that enables us to turn different sounds we hear into the sophisticated languages found across different human cultures?

What Is Language?

Listen to the Audio

Language is one of the most intensively studied areas in all of psychology. Thousands of experiments have been performed to identify different characteristics of language as well as the brain regions associated with them. But all fields of study have a birthplace. In the case of the scientific study of language, it began with an interesting case study of a patient in Paris in the early 1860s.

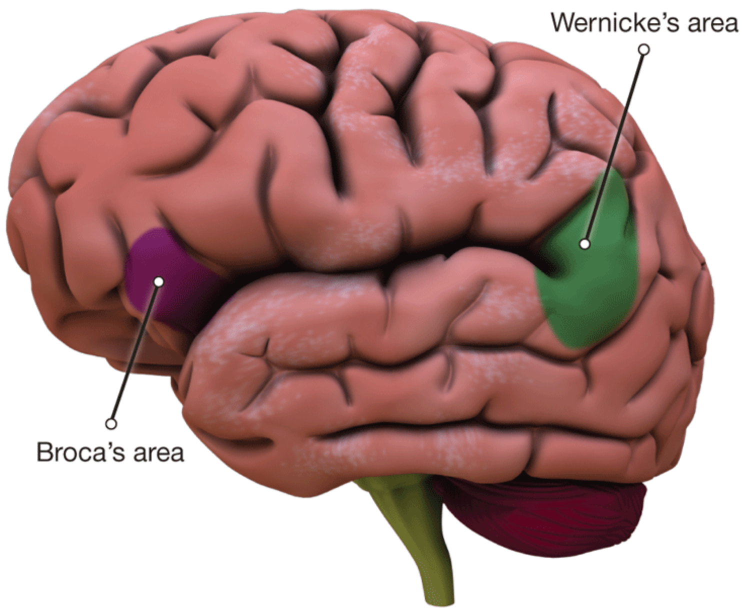
Early Studies of Language

Listen to the Audio

In 1861, Paul Broca, a physician and founder of the Society of Anthropology of Paris, heard of an interesting medical case. The patient appeared to show a very specific impairment resulting from a stroke suffered 21 years earlier. He could understand speech and had fairly normal mental abilities; however, he had great difficulty *producing* speech and often found himself uttering single words separated by pauses (uh, er . . .). In fact, this patient acquired the nickname "Tan" because it was one of the only sounds that he could reliably produce. Tan had what is known as **aphasia**, *a language disorder caused by damage to the brain structures that support using and understanding language*.

Tan died a few days after being examined by Broca. During the autopsy, Broca noted that the brain damage appeared primarily near the back of the frontal lobes in the left hemisphere. Over the next couple of years, Broca found 12 other patients with similar symptoms and similar brain damage, indicating that Tan was not a unique case. This *region of the left frontal lobe that controls our ability to articulate speech sounds that compose words* became known as **Broca's area** (see Figure 8.20). The symptoms associated with damage to this region, as seen in Tan, are known as *Broca's aphasia*.

Figure 8.20 Two Language Centres of the Brain



Broca's and Wernicke's areas of the cerebral cortex were among the first to be associated with language.

The fact that a brain injury could affect one part of language while leaving others preserved suggested that the ability to use language involves a number of different processes using different areas of the brain. In the years following the publication of Broca's research, other isolated language impairments were discovered. In 1874, a young Prussian (German) physician named Carl Wernicke published a short book detailing his study of different types of aphasia. Wernicke noted that some of his patients had trouble with language *comprehension* rather than language *production*. These patients typically had damage to the posterior superior temporal gyrus (the back and top part of the temporal lobe). This region came to be known as **Wernicke's area**, *the area of the brain most associated with finding the meaning of words* (see Figure 8.20). Damage to this area results in *Wernicke's aphasia*, a language disorder in which a person has difficulty understanding the words he or she hears. These patients are also unable to produce speech that other people can understand—the words are spoken fluently and with a normal intonation

and accent, but these words seem randomly thrown together (i.e., what is being said does not make sense). Consider the following example:

> *Examiner:* I'd like to have you tell me something about your problem.
>
> *Person with Wernicke's aphasia:* Yes, I, ugh, cannot hill all of my way. I cannot talk all of the things I do, and part of the part I can go alright, but I cannot tell from the other people. I usually most of my things. I know what can I talk and know what they are, but I cannot always come back even though I know they should be in, and I know should something eely I should know what I'm doing . . .

The important thing to look for in this sample of speech is how the wrong words appear in an otherwise fluent stream of utterances. Contrast this with an example of Broca's aphasia:

> *Examiner:* Tell me, what did you do before you retired?
>
> *Person with Broca's aphasia:* Uh, uh, uh, pub, par, partender, no.
>
> *Examiner:* Carpenter?
>
> *Person with Broca's aphasia:* (Nodding to signal yes) Carpenter, tuh, tuh, twenty year.

Notice that the individual has no trouble understanding the question or coming up with the answer. His difficulty is in producing the word *carpenter* and then putting it into an appropriate phrase. Did you also notice the missing "s" from *twenty year*? This is another characteristic of Broca's aphasia: The individual words are often produced without normal grammatical flair: no articles, suffixes, or prefixes.

Broca's aphasia can include some difficulties in comprehending language as well. In general, the more complex the sentence structure, the more difficult it will be to understand. Compare these two sentences:

> The girl played the piano.
>
> The piano was played by the girl.

These are two grammatically correct sentences (although the second is somewhat awkward) that have the same meaning but are structured differently. Patients with damage to Broca's area would find it much more difficult to understand the second sentence than the first. This impairment suggests that the distinction between speech production and comprehension is not as simple as was first thought.

Broca and Wernicke reported their clinical work around 150 years ago, before anyone thought about the psychology of language. In the late 20th century, language became a central topic of research in psychology, and researchers quickly realized that this ability—or set of abilities—is among the most complex processes humans perform. Because of this, you are unlikely to find professionals such as neuropsychologists or speech pathologists referring to Broca's area and Wernicke's area by those names. Instead, research has progressed to the point where professionals can see the brain in much more detail (Tremblay & Dick, 2016). Still, Broca and Wernicke provide an interesting beginning to the study of language, and a useful way of thinking about the elements of language to those of us who merely use it, rather than study all of its intricacies.

Properties of Language

Listen to the Audio

Language, like many other cognitive abilities, flows so automatically that we often overlook how complicated it really is. However, cases like those just described show us that language is indeed a complex set of skills. Researchers define **language** as *a form of communication that involves the use of spoken, written, or gestural symbols that are combined in a rule-based form*. With this definition in mind, we can distinguish which features of language make it a unique form of communication.

- Language can involve communication about objects and events that are not in the present time and place. We can use language to talk about events happening on another planet or that are happening within atoms. We can also use different tenses to indicate that the topic of the sentence occurred or will occur at a different time. For instance, you can say to your roommate, “I’m going to order pizza tonight,” without them thinking the pizza is already there.
- Languages can produce entirely new meanings. It is possible to produce a sentence that has never been uttered before in the history of humankind, simply by reorganizing words in different ways. As long as you select English words and use correct grammar, others who know the language should be able to understand it. You can also use words in novel ways. Imagine the tabloid newspaper headline: *Bat Boy Found in Cave!* In North American culture, “bat boys” are regular kids who keep track of the baseball bats for baseball players. In this particular tabloid, the story concerned a completely novel

creature that was part bat and part boy. Both meanings could be correct, depending upon the context in which the term *bat boy* is used.

- Language is passed down from parents to children. As we will discuss later in this module, children learn to pay attention to the particular sounds of their native language(s) at the expense of other sounds (Werker, 2003). Children also learn words and grammatical rules from parents, teachers, and peers. In other words, even if we have a natural inclination to learn *a* language, experience dictates *which* language(s) we will speak.

Language requires us to link different sounds (or gestures) with different meanings in order to understand and communicate with other people. Therefore, understanding more about these seemingly simple elements of language is essential for understanding language as a whole.

Words can be arranged or combined in novel ways to produce ideas that have never been expressed before.

Weekly World News

Phonemes and Morphemes: The Basic Ingredients of Language

Listen to the Audio

Languages contain discrete units that exist at differing levels of complexity. When people speak, they assemble these units into larger and more complex units. Some psychologists have used a cooking analogy to explain this phenomenon: We all start with the same basic language ingredients, but they can be mixed together in an unlimited number of ways (Pinker, 1999).

Phonemes *are the most basic of units of speech sounds*. You can identify phonemes rather easily; the phoneme associated with the letter *t* (which is written as/t/, where the two forward slashes indicate a phoneme) is found at the end of the word *pot* or near the beginning of the word *stop*. If you pay close attention to the way you use your tongue, lips, and vocal cords, you will see that phonemes have slight variations depending on the other letters around them. Pay attention to how you pronounce the/t/phoneme in *stop*, *stash*, *stink*, and *stoke*. Your mouth will move in slightly different ways each time, and there will be very slight variations in sound, but they are still the same basic phoneme. Individual phonemes typically do not have any meaning by themselves; if you want someone to stop doing something, asking him to/t/will not suffice.

Morphemes *are the smallest meaningful units of a language*. Some morphemes are simple words, whereas others may be suffixes or prefixes. For example, the word *pig* is a morpheme—it cannot be broken down into

smaller units of meaning. You can combine morphemes, however, if you follow the rules of the language. If you want to pluralize *pig*, you can add the morpheme/-s/, which will give you *pigs*. If you want to describe a person as a pig, you can add the morpheme/-ish/to get *piggish*. In fact, you can add all kinds of morphemes to a word as long as you follow the rules. You could even say *piggable* (able to be pigged) or *piggify* (to turn into a pig). These words do not make much literal sense, but they combine morphemes according to the rules; thus we can make a reasonable guess as to the speaker's intended meaning. Our ability to combine morphemes into words is one distinguishing feature of language that sets it apart from other forms of communication (e.g., we don't produce a lengthy series of facial expressions to communicate a new idea). In essence, language gives us *productivity*—the ability to combine units of sound into an infinite number of meanings.

Review Distinguishing Phonemes from Morphemes

Study the table, then select "Check Your Understanding" to test your knowledge.

Phoneme	Morpheme	Both
/k/	/dis/	/s/
/t/	/ed/	
/p/	/cat/	

Check Your Understanding

Finally, there are the words that make up a language. **Semantics** *is the study of how people come to understand meaning from words*. Humans have a knack for this kind of interpretation, and each of us has an extensive mental dictionary to prove it. Not only do most speakers know tens of thousands of words, but they can often understand new words they have never heard before based on their understanding of morphemes.

Although phonemes, morphemes, and semantics have an obvious role in spoken language, they also play a role in our ability to read. When you recognize a word, you effortlessly translate the word's visual form (known as its *orthography*) into the sounds that make up that word (known as its *phonology* or *phonological code*). These sounds are combined into a word, at which point you can access its meaning or semantics. However, not all people are able to translate orthography into sounds. Individuals with *dyslexia* have difficulties translating words into speech sounds. Indeed, children with dyslexia show less activity in the left fusiform cortex (at the bottom of the brain where the temporal and occipital lobes meet), a brain area involved with word recognition and with linking word and sound representations (Desroches et al., 2010). This difficulty linking letters with phonemes leads to unusually slow reading in both children and adults despite the fact that these people have normal hearing and are cognitively and neurologically healthy (Desroches & Joanisse, 2009; Shaywitz, 1998).

This research into the specific impairments associated with dyslexia allows scientists and educators to develop treatment programs to help children improve their reading and language abilities. One of the most successful programs has been developed by Maureen Lovett and her colleagues at the Hospital for Sick Children in Toronto and Brock University. Their Phonological and Strategy Training (PHAST) program (now marketed as Empower™ Reading to earn research money for the hospital) has been used to assist over 6000 students with reading

disabilities. Rather than focusing on only one aspect of language, this program teaches children new word-identification and reading-comprehension strategies while also educating them about how words and phrases are structured (so that they know what to expect when they see new words or groups of words). Children who completed these programs showed improvements on a number of measures of reading and passage comprehension (Frijters et al., 2013; Lovett et al., 2012). Given that 5% to 15% of the population has some form of reading impairment, treatment programs like PHAST could have a dramatic effect on our educational system.

As you can see, languages derive their complexity from several elements, including phonemes, morphemes, and semantics. And when these systems are not functioning properly, language abilities suffer. But phonemes, morphemes, and semantics are just the list of the ingredients of language—we still need to figure out how to mix these ingredients together.

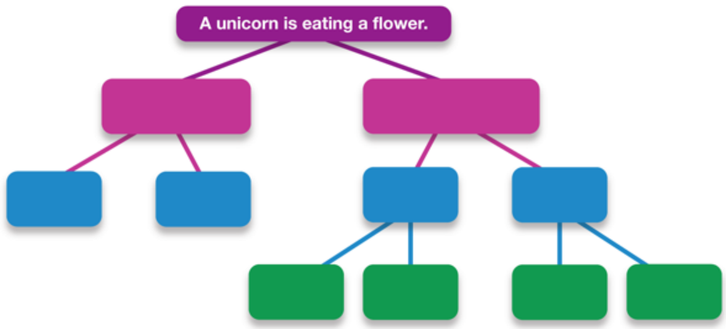
Syntax: The Language Recipe

Listen to the Audio

Perhaps the most remarkable aspect of language is **syntax**, *the rules for combining words and morphemes into meaningful phrases and sentences*—the recipe for language. Children master the syntax of their native language before they leave elementary school. They can string together morphemes and words when they speak, and they can easily distinguish between well-formed *and* ill-formed sentences. But despite mastering those rules, most speakers cannot tell you what the rules are; syntax just seems to come naturally. It might seem odd that people can do so much with language without a full understanding of its inner workings. Of course, people can also learn how to walk without any understanding of the biochemistry that allows their leg muscles to contract and relax.

The most basic units of syntax are nouns and verbs. They are all that is required to construct a well-formed sentence, such as *Goats eat*. Noun–verb sentences are perfectly adequate, if a bit limited, so we build phrases out of nouns and verbs, as the diagram in Figure 8.21 demonstrates.

Figure 8.20 Syntax: The Structure and Rules of a Language



The rules of syntax help us divide a sentence.

1 of 4 Previous Next

Source: Adapted from *The Language Instinct* by S. Pinker, HarperCollins, 1994.

Syntax also helps explain why the order of words in a sentence has such a strong effect on what the sentence means. For example, how would you make a question out of this statement?

A. *A goat is in the garden*.
B. IS *a goat in the garden?*

This example demonstrates that a statement (A) can be turned into a well-formed question (B) just by moving the verb *is* to the beginning of the sentence. Perhaps that is one of the hidden rules of syntax. Try it again:

A. *A goat that is eating a flower is in the garden*.
B. IS *a goat that eating a flower is in the garden?*

As you can see, the rule "move *is* to the beginning of the sentence" does not apply in this case. Do you know why? It is because we moved the wrong *is*. The phrase *that is eating a flower* is a part of the noun phrase because it describes the goat. We should have moved the *is* from the verb phrase. Try it again:

A. *A goat that is eating a flower is in the garden*.
B. <u>IS</u> *a goat that is eating a flower in the garden?*

This is a well-formed sentence. It may be grammatically awkward, but the syntax is understandable (Pinker, 1994).

As you can see from these examples, the order of words in a sentence helps determine what the sentence means, and syntax is the set of rules we use to determine that order.

Pragmatics: The Finishing Touches

Listen to the Audio

If syntax is the recipe for language, pragmatics is the icing on the cake. **Pragmatics** *is the study of nonlinguistic elements of language use*. It places heavy emphasis on the speaker's behaviours and the social situation (Carston, 2002).

Pragmatics reminds us that sometimes *what* is said is not as important as *how* it is said. For example, a student who says, "I ate a 50-pound cheeseburger" is most likely stretching the truth, but you probably would not call him a liar. Pragmatics helps us understand what he implied. The voracious student was actually *flouting*—or blatantly disobeying—a rule of language in a way that is obvious (Grice, 1975; Horn & Ward, 2004). There are all sorts of ways in which flouting the rules can lead to implied, rather than literal, meanings; samples of these are shown in Table 8.3.

Table 8.3 Pragmatic Rules Guiding Language Use

Table 8.3 Pragmatic Rules Guiding Language Use

The Rule	Flouting the Rule	The Implication
Say what you believe is true.	My roommate is a *giraffe*.	He does not *really* live with a giraffe. Maybe his roommate is very tall?
Say only what is relevant.	Is my blind date good-looking? *He's got a great personality*.	She didn't answer my question. He's probably not good-looking.
Say only as much as you need to.	I like my lab partner, but he's no *Einstein*.	Of course he's not Einstein. Why is she bothering to tell me this? She probably means that her partner is not very smart.

Importantly, pragmatics depends upon both the speaker (or writer) and listener (or reader) understanding that rules are being flouted in order to produce a desired meaning. If you speak with visitors from a different country, you may find that they don't understand what you mean when you flout the rules of Canadian English or use slang (shortened language). When we say "The goalie stood on his head," most hockey-mad Canadians understand that we are commenting on a goaltender's amazing game; however, someone new to hockey would be baffled by this expression. This is another example of how experience—in this case with a culture—influences how we use and interpret language.

The Development of Language

Listen to the Audio

Human vocal tracts are capable of producing approximately 200 phonemes. However, no language uses all of these sounds. Jul'hoan, one of the "clicking languages" of Botswana, contains almost 100 sounds (including over 80 different consonant sounds). In contrast, English contains about 40 sounds. But if Canadians are genetically identical to people in southern Africa, why are our languages different? And why can't we produce and distinguish between some of the sounds of these other languages? It turns out that experience plays a major role in your ability to speak the language, or languages, that you do.

Infants, Sound Perception, and Language Acquisition

Listen to the Audio

Say the following phrase out loud: “Your doll.” Now, say this phrase: “This doll.” Did you notice a difference in how you pronounced *doll* in these two situations? If English is your first language, it is quite likely that you didn’t notice the slight change in how the letter *d* was expressed. But Hindi speakers would have no problem making this distinction. To them, the two instances of the word *doll* would be pronounced differently and would mean *lentils* and *branch*, respectively.

Janet Werker of the University of British Columbia and her colleagues found that very young English-learning infants are able to distinguish between these two *d* sounds. But, by 10 months of age, the infants begin hearing sounds in a way that is consistent with their native language; because English has only one *d* sound, English-learning infants stop detecting the difference between these two sounds (Werker & Tees, 1984; Werker et al., 2012). This change is not a weakness on the part of English-learning infants. Rather, it is evidence that they are learning the statistical principles of their language. Infants who hear only English words will group different pronunciations of the letter *d* into one category because that is how this sound is used in English. Hindi-learning children will learn to separate different types of *d* sounds because this distinction is important. A related study using two *k* sounds from an Interior Salish (Indigenous) language from British Columbia produced similar results—

English-learning infants showed a significant drop-off in hearing sounds for the non-English language after 8 to 10 months (Werker & Tees, 1984).

In addition to becoming experts at identifying the sounds of their own language, infants also learn how to separate a string of sounds into meaningful groups (i.e., into words). Infants as young as two months old show a preference for speech sounds over perceptually similar non-speech sounds (Vouloumanos & Werker, 2004). And, when presented with pronounceable non-words (e.g., *strak*), infants prefer to hear words that follow the rules of their language. An English-learning baby would prefer non-words beginning in *str* to those beginning in *rst* because there are a large number of English words that begin with *str* (Jusczyk et al., 1993). Additionally, newborn infants can distinguish between function words (e.g., prepositions) and content words (e.g., nouns and verbs) based on their sound properties (Shi et al., 1999). By six months of age, infants prefer the content words (Shi & Werker, 2001), thus showing that they are learning which sounds are most useful for understanding the meaning of a statement.

By the age of 20 months, the children are able to use the perceptual categories that they developed in order to rapidly learn new words. In some cases, children can perform **fast mapping**—*the ability to map words onto concepts or objects after only a single exposure*. Human children seem to have a fast-mapping capacity that is superior to any other organism on the planet. This skill is one potential explanation for the *naming explosion*, a rapid increase in vocabulary size that occurs at this stage of development.

The naming explosion has two biological explanations as well. First, at this stage of development, the brain begins to perform language-related functions in the left hemisphere, similar to the highly efficient adult brain; prior to this stage, this information was stored and analyzed by both

hemispheres (Mills et al., 1997). Second, the naming explosion has also been linked to an increase in the amount of myelin on the brain's axons, a change that would increase the speed of communication between neurons (Pujol et al., 2006). These changes would influence not only the understanding of language, but also how a child uses language to convey increasingly complex thoughts such as "How does Spider-Man stick to walls?" and "Why did Dad's hair fall out?"

Producing Spoken Language

Listen to the Audio

Learning to identify and organize speech sounds is obviously an important part of language development. An equally critical skill is producing speech that other people will be able to understand. Early psychologists focused only on behavioural approaches to language learning. They believed that language was learned through imitating sounds and being reinforced for pronouncing and using words correctly (Skinner, 1985). Although it is certainly true that imitation and reinforcement are involved in language acquisition, they are only one part of this complex process (Messer, 2000). Here are a few examples that illustrate how learning through imitation and reinforcement is just one component of language development:

- Children often produce phrases that include incorrect grammar or word forms. Because adults do not (often) use these phrases, it is highly unlikely that such phrases are imitations.
- Children learn irregular verbs and pluralizations on a word-by-word basis. At first, they will use *ran* and *geese* correctly. However, when children begin to use grammar on their own, they over-generalize the rules. A child who learns the/-ed/morpheme for past tense will start saying *runned* instead of *ran*. When they learn that/-s/means more than one, they will begin to say *gooses* instead of *geese*. It is also unlikely that children would produce these forms by imitating.
- When children use poor grammar, or when they over-generalize their rules, parents may try to correct them. Although children will

acknowledge their parents' attempts at instruction, this method does not seem to work. Instead, children go right back to over-generalizing.

In light of these and many other examples, it seems clear that an exclusively behaviourist approach falls short in explaining how language is learned. After all, there are profound differences in the success of children and adults in learning a new language: Whereas adults typically struggle, children seem to learn the language effortlessly. If reinforcement and imitation were the primary means by which language was acquired, then adults should be able to learn just as well as children.

The fact that children seem to learn language differently than adults has led psychologists to use the term *language acquisition* when referring to children instead of *language learning*. The study of language acquisition has revealed remarkable similarities among children from all over the world. Regardless of the language, children seem to develop this capability in stages, as shown in Table 8.4.

Table 8.4 Milestones in Language Acquisition and Speech

Table 8.4 Milestones in Language Acquisition and Speech

Average Time of Onset (Months)	Milestone	Example
1–2	Cooing	Ahhh, ai-ai-ai
4–10	Babbling (consonants start)	Ab-ah-da-ba
8–16	Single-word stage	Up, mama, papa
24	Two-word stage	Go potty
24+	Complete, meaningful phrases strung together	I want to talk to Grandpa.

Sensitive Periods for Language

Listen to the Audio

The phases of language development described above suggest that younger brains are particularly well-suited to acquiring languages; this is not the case for older brains. Imagine a family with two young children who immigrated to Canada from a remote Russian village where no one spoke English. The parents would struggle with English courses, while the children would attend English-speaking schools. Within a few years, the parents would have accumulated some vocabulary but they would likely still have difficulty with pronunciation and grammar (Russian-speaking people often omit articles such as *the*). Meanwhile, their children would likely pick up English without much effort and have language skills equivalent to those of their classmates; they would have roughly the same vocabulary, the same accents, and even the same slang.

Why can children pick up a language so much more easily than adults? Most psychologists agree that there is a *sensitive period* for language—a time during childhood in which children's brains are primed to develop language skills (see also Module 10.1). Children can absorb language almost effortlessly, but this ability seems to fade away starting around age seven. Thus, when families immigrate to a country that uses a different language, young children are able to pick up this language much more quickly than their parents (Hakuta et al., 2003; Hernandez & Li, 2007).

A stunning example of critical periods comes from Nicaragua. Until 1979, there was no sign language in this Central American country. Because

there were no schools for people with hearing impairments, there was no (perceived) need for a common sign language. When the first schools for the deaf were established, adults and teenaged students attempted to learn to read lips. While few mastered this skill, these students did do something even more astonishing: They developed their own primitive sign language. This language, *Lenguaje de Signos Nicaragüese (LSN)*, involves a number of elaborate gestures similar to a game of charades and did not have a consistent set of grammatical rules. But it was a start. Children who attended these schools at an early age (i.e., during the sensitive period for language acquisition) used this language as the basis for a more fluent version of sign language: *Idioma de Signos Nicaragüese (ISN)*. ISN has grammatical rules and can be used to express a number of complicated, abstract ideas (Pinker, 1994). It is now the standard sign language in Nicaragua. The difference between LSN and ISN is similar to the difference between adults and children learning a new language. If you acquire the new language during childhood, you will be much more fluent than if you try to acquire it during adulthood (Senghas, 2003; Senghas et al., 2004).

The Bilingual Brain

Listen to the Audio

Let's go back to the example of the Russian-speaking family who immigrated to balmy Canada. The young children learning English would also be speaking Russian at home with their parents. As a result, they would be learning two languages essentially at the same time. What effect would this situation have on their ability to learn each language?

Bilingualism leads to many benefits (see below), but there are some costs associated with it as well. Bilingual children tend to have a smaller vocabulary in each language than unilingual children (Mahon & Crutchley, 2006). In adulthood, this difference is shown not by vocabulary size, but by how easily bilinguals can access words. Compared to unilingual adults, bilingual adults are slower at naming pictures (Roberts et al., 2002), have more difficulty on tests that ask them to list words starting with a particular letter (Rosselli et al., 2000), and have more tip-of-the-tongue experiences in which they can't quite retrieve a word (Gollan & Acenas, 2004). These problems with accessing words may be due to the fact that they use each language less than a unilingual person would use their single language (Michael & Gollan, 2005). So, clearly bilingualism comes at a cost; fortunately, these costs are relatively cheap.

The benefits of bilingualism appear to far outweigh the costs. One difference that has been repeatedly observed is that bilingual individuals are much better than their unilingual counterparts on tests that require

them to control their attention or their thoughts. These abilities, known as *executive functions* (or *executive control*), enable people who speak more than one language to inhibit one language while speaking and listening to another (or to limit the interference across languages). If they didn't, they would produce confusing sentences like *The chien is tres sick*. Although most of you can figure out that this person is talking about a sick dog, you can see how such sentences would make communication challenging. Researchers have found that bilinguals score better than unilinguals on tests of executive control throughout the lifespan, beginning in infancy (Kovacs & Mehler, 2009) and the toddler years (Poulin-Dubois et al., 2011) and continuing throughout adulthood (Costa et al., 2008) and into old age (Bialystok et al., 2004). Bilingualism has also recently been shown to have important health benefits. Because the executive control involved with bilingualism uses areas in the frontal lobes, these regions may form more connections in bilinguals than unilinguals (Bialystok, 2009, 2011a, 2011b). As a result, these brains likely have more back-up systems if damage occurs. Indeed, Ellen Bialystok at York University and her colleagues have shown that being bilingual helps protect against the onset of dementia and Alzheimer's disease (Bialystok et al., 2007; Schweizer et al., 2012), a finding that leaves many at a loss for words.

Watch **Thinking Like a Psychologist** Multilingualism: Speaking One's Mind

---

Genes, Evolution, and Language

Listen to the Audio

This module began with a discussion of two brain areas that are critical for language production and comprehension: Broca's area and Wernicke's area, respectively. But, these brain areas didn't appear out of nowhere. Rather, genetics and evolutionary pressures led to the development of our language-friendly brains. Given recent advances in our understanding of the human genome (see Module 3.1), it should come as no surprise that researchers are actively searching for the genes involved with language abilities.

The fact that animals such as songbirds have some of the same language-related genes as humans suggests that other species may have *some* language abilities. As it turns out, many monkey species have areas in their brains that are similar to Broca's and Wernicke's area. As in humans, these regions are connected by white-matter pathways, thus allowing the areas to communicate with each other (Galaburda & Pandya, 1982). These areas appear to be involved with the control of facial and throat muscles and with identifying when other monkeys have made a vocalization. This is, of course, a far cry from human language. But the fact that some monkey species have similar "neural hardware" to humans does lead to some interesting speculations about language abilities in the animal kingdom.

Working the Scientific Literacy Model

Genes and Language

Listen to the Audio

Given that language is a universal trait of the human species, it likely involves a number of different genes. These genes would, of course, also interact with the environment. In this section we examine whether it is possible that specific genes are related to language.

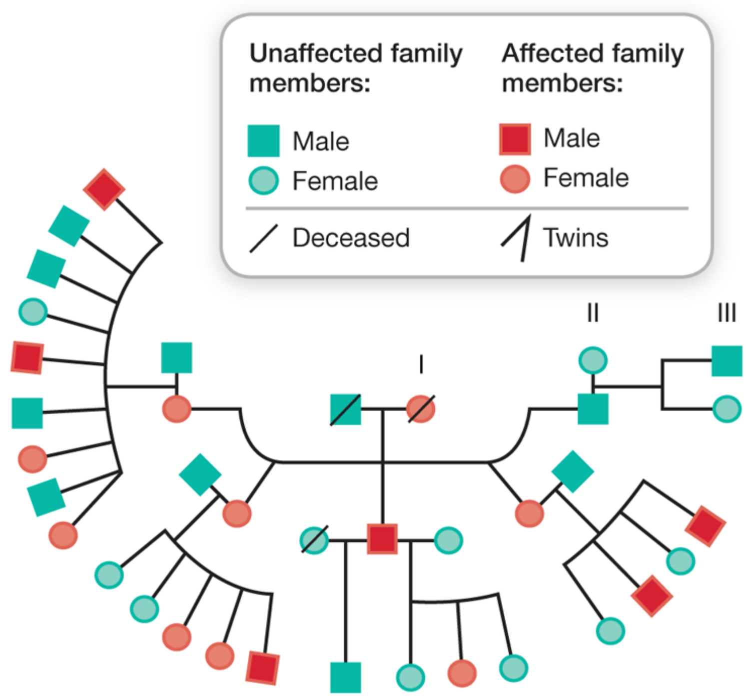
What do we know about genes and language?

Many scientists believe that the evidence is overwhelming that language is a unique feature of the human species, and that language evolved to solve problems related to survival and reproductive fitness. Language adds greater efficiency to thought, allows us to transmit information without requiring us to have direct experience with potentially dangerous situations, and, ultimately, facilitates communicating social needs and desires. Claims that language promotes survival and reproductive success are difficult to test directly with scientific experimentation, but there is a soundness to the logic of the speculation. We can also move beyond speculation and actually examine how genes play a role in human language. As with all complex psychological traits, there are likely many genes associated with language. Nevertheless, amid all of these myriad possibilities, one gene has been identified that is of particular importance.

How can science explain a genetic basis of language?

Studies of this gene initially focused on the KE family (their name is abbreviated to maintain their confidentiality). Many members of this family have inherited a mutated version of a gene on chromosome 7 (see Figure 8.22; Vargha-Khadem et al., 2005). Each gene has a name—and this one is called FOXP2. All humans carry a copy of the FOXP2 gene, but the KE family passes down a mutated copy. Those who inherit the mutated copy have great difficulty putting thoughts into words (Tomblin et al., 2009). Since the original studies of the KE family, additional studies on other families have confirmed the role of FOXP2 in language production (Reuter et al., 2017). Thus, it appears that the physical and chemical processes that FOXP2 codes for are related to language function.

Figure 8.22 Inheritance Pattern for the Mutated FOXP2 Gene in the KE Family



Family members who are "affected" have inherited a mutated form of the FOXP2 gene, which results in difficulty with

articulating words. As you can see from the centre of the figure, the mutated gene is traced to a female family member and has been passed on to the individuals of the next two generations.

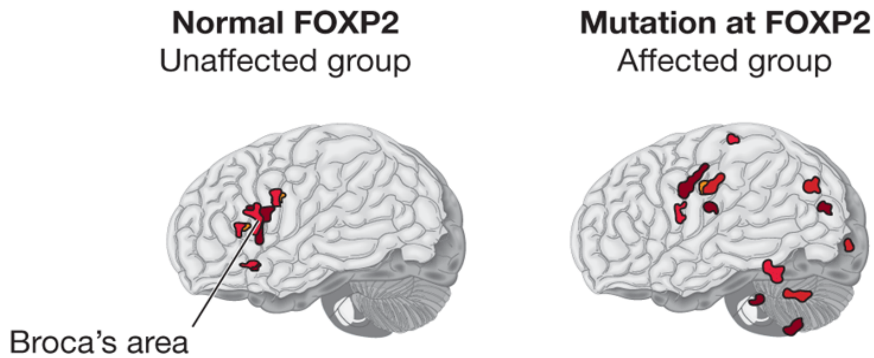
Source: Republished with permission of Nature Publishing Group, from Vargha-Khadem, F., Gadian, D. G., Copp, A., & Mishkin, M. (2005). FOXP2 and the neuroanatomy of speech and language, Fig. 1, *Nature Reviews Neuroscience*, 6, 131–138.

What evidence indicates that this gene is specifically involved in language? If you were to ask the members of the family who inherited the mutant form of the gene to speak about how to change the batteries in a flashlight, they would be at a loss. A rather jumbled mixture of sounds and words might come out, but nothing that could be easily understood. However, these same individuals have no problem actually performing the task. Their challenges with using language are primarily restricted to the use of words, not with their ability to *think*.

Scientists have used brain imaging methods to further test whether the FOXP2 mutation affects language. One group of researchers compared brain activity of family members who inherited the mutation of FOXP2 with those who did not (Liégeois et al., 2003). During the brain scans, the participants were asked to generate words themselves, and also to repeat words back to the experimenters. As you can see from Figure 8.23, the members of the family who were unaffected by the mutation showed normal brain activity: Broca's area of the left hemisphere became activated, just as expected. In contrast, Broca's area in the affected family members was silent, and the brain activity that did occur was unusual for this type of task.

Figure 8.23

Brain Scans Taken While Members of the KE Family Completed a Speech Task



The unaffected group shows a normal pattern of activity in Broca's area, while the affected group shows an unusual pattern.

Source: Figure 1 republished with permission of Nature Publishing Group, from Liégeois, F., Badeweg, T., Connelly, A., Gadian, D. G., Mishkin, M., & Vargha-Khadem, F. (2003). Language fMRI abnormalities associated with FOXP2 gene mutation, Figure 1, *Nature Neuroscience*, *6*, 1230–1237, Copyright © 2003. permission conveyed through Copyright Clearance Center, Inc.

Can we critically evaluate this evidence?

As you have now read, language has multiple components. Being able to articulate words is just one of many aspects of using and understanding language. The research on FOXP2 is very important, but reveals only how a single gene relates to one aspect of language use. There are almost certainly a large number of genes working together to produce *each* component of language. To their credit, FOXP2 researchers are quick to point out that many other genes will need to be identified before we can claim to understand the genetic basis of language; FOXP2 is just the beginning.

It is also worth noting that although the FOXP2 gene affects human speech production, it does occur in other species that do not produce sophisticated language. This gene is found in both mice and birds as well as in humans, and the human version shares a very similar molecular structure to the versions observed in these other species. Interestingly, the molecular structure and activity of the FOXP2 gene in songbirds (unlike non-songbirds) is

similar to that in humans, again highlighting its possible role in producing meaningful sounds (Vargha-Khadem et al., 2005).

Why is this relevant?

This work illuminates at least part of the complex relationship between genes and language. Other individual genes that have direct links to language function will likely be discovered as research continues. It is possible that this information could be used to help us further understand the genetic basis of language disorders. The fact that the FOXP2 gene is found in many other species suggests that it may play a role in one of the components of language rather than being *the* gene for language. Thus, scientists will have to perform additional research in order to understand why and how human language became so much more complex than that of any other species.

Can Animals Use Language?

Listen to the Audio

Psychologists have been studying whether nonhuman species can acquire human language for many decades. Formal studies of language learning in nonhuman species gained momentum in the mid-1950s when psychologists attempted to teach spoken English to a chimpanzee named Viki (Hayes & Hayes, 1951). Viki was **cross-fostered**, *meaning that she was raised as a member of a family that was not of the same species*. Like humans, chimps come into the world dependent on adults for care, so the humans who raised Viki were basically foster parents. Although the psychologists learned a lot about how smart chimpanzees can be, they did not learn that Viki was capable of language—she managed to whisper only about four words after several years of trying.

Psychologists who followed in these researchers' footsteps did not consider the case to be closed. Perhaps Viki's failure to learn spoken English was a limitation not of the brain, but of physical differences in the vocal tract and tongue that distinguish humans and chimpanzees. One project that began in the mid-1960s involved teaching chimpanzees to use American Sign Language (ASL). The first chimpanzee involved in this project was named Washoe. The psychologists immersed Washoe in an environment rich with ASL, using signs instead of speaking and keeping at least one adult present and communicating with her throughout the day. By the time she turned two years old, Washoe had acquired about 35 signs through imitation and direct guidance of how to configure and move her hands. Eventually, she learned approximately 200 signs. She

was able to generalize signs from one context to another and to use a sign to represent entire categories of objects, not just specific examples. For example, while Washoe learned the sign for the word *open* on a limited number of doors and cupboards, she subsequently signed "open" to many different doors, cupboards, and even her pop bottles. The findings with Washoe were later replicated in other chimps (Gardner et al., 1989).

Washoe was the first chimpanzee taught to use some of the signs of American Sign Language. Washoe died in 2007 at age 42 and throughout her life challenged many to examine their beliefs about human uniqueness.

Photo permission granted by Friends of Washoe

Instead of using sign language, some researchers have developed a completely artificial language to teach to apes. This language consists of symbols called *lexigrams*—small keys on a computerized board that represent words and, therefore, can be combined to form complex ideas and phrases. One subject of the research using this language is a bonobo named Kanzi (bonobos are another species of chimpanzee). Kanzi has learned approximately 350 symbols through training, but he learned his first symbols simply by watching as researchers attempted to teach his mother how to use the language. In addition to the lexigrams he produces, Kanzi seems to recognize about 3000 spoken words. His trainers claim that Kanzi's skills constitute language (Savage-Rumbaugh & Lewin, 1994). They argue that he can understand symbols and at least some syntax; that he acquired symbols simply by being around others who used them; and that he produced symbols without specific training or reinforcement. Those who work with Kanzi conclude that his communication skills are quite similar to those of a young human in terms of both the elements of language (semantics and syntax) and the acquisition of language (natural and without effortful training).

Despite their ability to communicate in complex ways, debate continues to swirl about whether these animals are using language. Many language researchers point out that chimpanzees' signing and artificial language use is very different from how humans use language. Is the vastness of the difference important? Is using 200 signs different in some critical way from being able to use 4000 signs, roughly the number found in the ASL dictionary (Stokoe et al., 1976)? If our only criterion for whether a communication system constitutes language is the number of words used, then we can say that nonhuman species acquire some language skills after extensive training. But as you have learned in this module, human language involves more than just using words. In particular, our manipulation of phonemes, morphemes, and syntax allow us to utter an

infinite number of words and sentences, thereby conveying an infinite number of thoughts.

Kanzi is a bonobo chimpanzee that has learned to use an artificial language consisting of graphical symbols that correspond to words. Kanzi can type out responses by pushing buttons with these symbols, shown in this photo. Researchers are also interested in Kanzi's ability to understand spoken English (which is transmitted to the headphones by an experimenter who is not in the room).

MICHAEL NICHOLS/National Geographic Creative

Some researchers who have worked closely with language-trained apes observed too many critical differences between humans and chimps to conclude that language extends beyond our species (Seidenberg & Pettito, 1979). For example:

- One major argument is that apes are communicating only with symbols, not with the phrase-based syntax used by humans. Although some evidence of syntax has been reported, the majority of

their “utterances” consist of single signs, a couple of signs strung together, or apparently random sequences.

- There is little reputable experimental evidence showing that apes pass their language skills to other apes.
- Productivity—creating new words (gestures) and using existing gestures to name new objects or events—is rare, if it occurs at all.
- Some of the researchers become very engaged in the lives of these animals and talk about them as friends and family members (Fouts, 1997; Savage-Rumbaugh & Lewin, 1994). This tendency has left critics to wonder the extent to which personal attachments to the animals might interfere with the objectivity of the data.

It must be pointed out that the communication systems of different animals have their own adaptive functions. It is possible that some species simply didn’t have a need to develop a complex form of language. However, in the case of chimpanzees, this point doesn’t hold true. Both humans and chimpanzees evolved in small groups in (for the most part) similar parts of the world; thus, chimpanzees would have faced many of the same social and environmental pressures as humans. However, their brains, although quite sophisticated, are not as large or well-developed as those of humans. It seems, therefore, that a major factor in humanity’s unique language abilities is the wonderful complexity and plasticity of the human brain.

Module 8.3 Summary

Listen to the Audio

8.3a Know . . . the key terminology from the study of language.

Review Module 8.3

Start Over | Swap | 0/11 REVIEWED · 0 MASTERED

pragmatics

Previous | Next | Got It!

8.3b Understand . . . how language is structured.

Sentences are broken down into words that are arranged according to grammatical rules (syntax). The relationship between words and their meaning is referred to as semantics. Words can be broken down into

morphemes, the smallest meaningful units of speech, and phonemes, the smallest sound units that make up speech.

8.3c Understand . . . how genes and the brain are involved in language use.

Studies of the KE family show that the FOXP2 gene is involved in our ability to speak. However, mutation to this gene does not necessarily impair people's ability to think. Thus, the FOXP2 gene seems to be important for just one of many aspects of human language. Multiple brain areas are involved in language—two particularly important ones are Broca's and Wernicke's areas.

8.3d Apply . . . your knowledge to distinguish between units of language such as phonemes and morphemes.

Apply Activity

Which of these represent a single phoneme and which represent a morpheme? Do any of them represent both?

1. /dis/
2. /s/
3. /k/

8.3e Analyze . . . whether species other than humans are able to use language.

Nonhuman species certainly seem capable of acquiring certain aspects of human language. Studies with apes have shown that they can learn and use some sign language or, in the case of Kanzi, an artificial language system involving arbitrary symbols. However, critics have pointed out

that many differences between human and nonhuman language use remain.

Chapter 9
Intelligence Testing

Listen to the Audio

9.1 Measuring Intelligence

- Different Approaches to Intelligence Testing
- The Checkered Past of Intelligence Testing
- Working the Scientific Literacy Model: Beliefs about Intelligence
- Module 9.1 Summary

9.2 Understanding Intelligence

- Intelligence as a Single, General Ability
- Intelligence as Multiple, Specific Abilities
- Working the Scientific Literacy Model: Testing for Fluid and Crystallized Intelligence
- The Battle of the Sexes
- Module 9.2 Summary

9.3 Biological, Environmental, and Behavioural Influences on Intelligence

- Biological Influences on Intelligence
- Working the Scientific Literacy Model: Brain Size and Intelligence

Environmental Influences on Intelligence

Behavioural Influences on Intelligence

Module 9.3 Summary

Module 9.1 Measuring Intelligence

Listen to the Audio

Leilani Muir, who passed away in Alberta in 2016.

The Canadian Press/*Edmonton Journal*.

Learning Objectives

9.1a Know . . . the key terminology associated with intelligence and intelligence testing.

9.1b Understand . . . the reasoning behind the eugenics movements and its use of intelligence tests.

9.1c Apply . . . the concepts of entity theory and incremental theory to help kids succeed in school.

9.1d Analyze . . . why it is difficult to remove all cultural bias from intelligence testing.

Leilani Muir kept trying to get pregnant, but to no avail. Frustrated, she asked her physician if there was a medical explanation. An examination found one, but it was totally unexpected; her fallopian tubes had been surgically destroyed, leaving her unable to ever conceive. How could this procedure happen without her knowledge?

Tragically, forced sterilization was a legal medical practice in the United States and parts of Canada for almost half of the 20th century. In 1928, Alberta passed the Sexual Sterilization Act, *giving doctors the power to sterilize people deemed to be "genetically unfit," often due to a very low score on an IQ test. Moreover, physicians could perform this procedure without a patient's consent or knowledge.*

Leilani Muir is one of the tens of thousands of victims of the misguided application of intelligence tests. Born into a poor farming family near Calgary, Alberta, Leilani was entered by her parents into the Provincial Training School for Mental Defectives when she was 11. A few years later, when given an intelligence test, she scored 64, which was below the 70 point cut-off required by law for forced sterilization. When she was 14, she was told by doctors she needed to have her appendix removed. Trusting these professionals, she went under the knife, never

knowing the full extent of the surgery she was about to undergo. After the surgery, she was never informed that her fallopian tubes had been destroyed, and had to find out on her own after her many attempts to get pregnant. Later in her life, Leilani had her IQ re-tested. She scored 89, which is close to average.

In 1996, Leilani received some measure of justice. She sued the government of Alberta and won her case, becoming the first person to receive compensation for injustices committed under the Sexual Sterilization Act. For her lifetime of not being able to have children, she received almost $750 000 in damages.

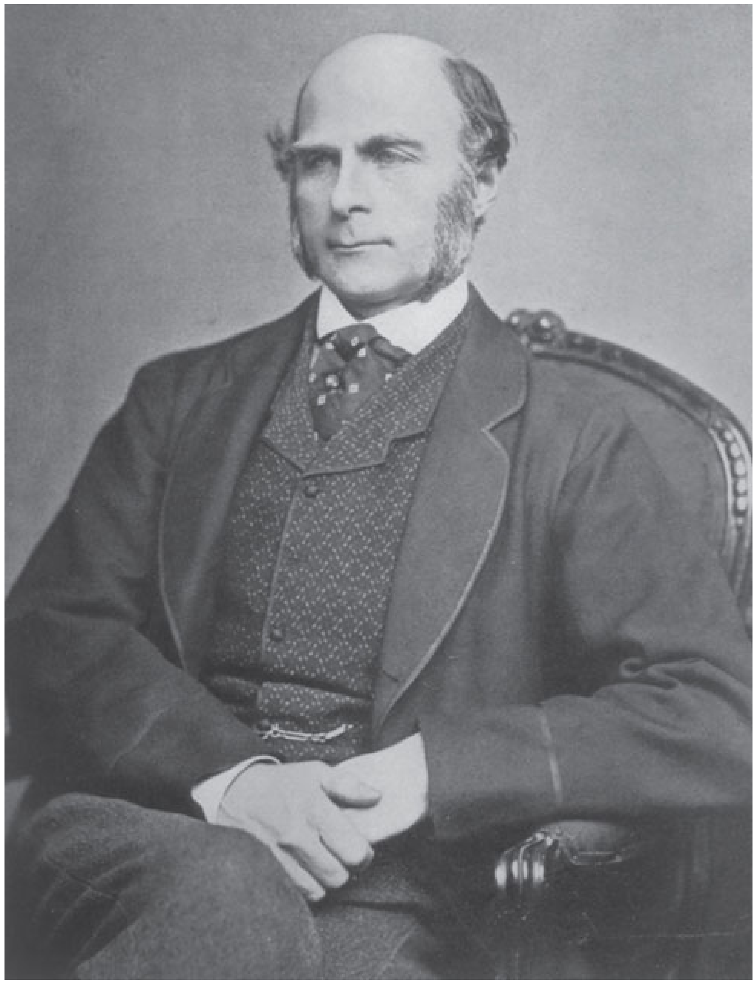
What happened to Leilani Muir seems almost unthinkable today. But this story also serves to drive home two extremely important truths about psychology, and science in general—it is extremely important to measure things properly and to interpret measurements cautiously. This may sound trite, but Leilani's story underscores the importance of ensuring that the research carried out in psychology and other disciplines is as rigorous as possible. Research isn't just about writing complicated articles that only scientists and academics read; its real-world implications can ripple through society and affect people's lives in countless ways. In Leilani's case, her misfortune was the result of both inhumane policies passed by the government and the failure to accurately measure her intelligence. Intelligence is not something like the length or mass of a physical object. There is no "objective" standard to which we can compare our measures to see if they are accurate. Instead, we have to rely upon rigorous testing of our methodologies.

So, how *can* we measure intelligence accurately? What does science say? As you will see in this module, this question is not easy to answer. Intelligence measures have a very checkered past, making the whole notion of intelligence one of the most hotly contested areas in all of psychology.

Different Approaches to Intelligence Testing

Listen to the Audio

Intelligence is a surprisingly difficult concept to define. You undoubtedly know people who earn similar grades even though one may seem to be "smarter" than the other. You likely also know people who do very well in school and have "book smarts," but have difficulty in many other aspects of life, perhaps lacking "street smarts." Furthermore, you may perceive a person to be intelligent or unintelligent, but how do you know your perceptions are not biased by their confidence, social skills, or other qualities? The history of psychology has seen many attempts to define and measure intelligence. In this module, we will examine some of the more influential of these attempts, and then explore some of the important social implications of intelligence testing.



Francis Galton believed that intelligence was something people inherit. Thus, he believed that an individual's relatives were a better predictor of intelligence than practice and effort.

Intelligence and Perception: Galton’s Anthropometric Approach

Listen to the Audio

The systematic attempt to measure intelligence in the modern era began with Francis Galton (1822–1911) (who is often given the appellation “Sir” because he was knighted in 1909). Galton believed that because people learn about the world through their senses, those with superior sensory abilities would be able to learn more about it. Thus, he argued, sensory abilities should be an indicator of a person’s intelligence. In 1884, Galton created a set of 17 sensory tests, such as the highest and lowest sounds people could hear or their ability to tell the difference between objects of slightly different weights, and began testing people’s abilities in his *anthropometric* laboratory. **Anthropometrics** (literally, “the measurement of people”) referred to *methods of measuring physical and mental variation in humans*. Galton’s lab attracted many visitors, allowing him to measure the sensory abilities of thousands of people in England (Gillham, 2001).

One of Galton’s colleagues, James McKeen Cattell, took his tests to the United States and began measuring the abilities of university students. This research revealed, however, that people’s abilities on different sensory tests were not correlated with each other, or only very weakly. For example, having exceptional eyesight seemed to signify little about whether one would have exceptional hearing. Clearly, this was a problem, because if two measures don’t correlate well with each other, then they can’t both be indicators of the same thing, in this case,

intelligence. Cattell also found that students' scores on the sensory tests did not predict their grades, which one would expect would also be an indicator of intelligence. As a result, Galton's approach to measuring intelligence was generally abandoned.

Intelligence and Thinking: The Stanford–Binet Test

Listen to the Audio

In contrast to Galton, a prominent French psychologist, Alfred Binet, argued that intelligence should be indicated by more complex thinking processes, such as memory, attention, and comprehension. This view has influenced most intelligence researchers up to the present day. They define **intelligence** as *the ability to think, understand, reason, and adapt to or overcome obstacles* (Neisser et al., 1996). From this perspective, intelligence reflects how well people are able to reason and solve problems, plus their accumulated knowledge.

In 1904, Binet and his colleague, Theodore Simon, were hired by the French government to develop a test to measure intelligence. At the end of the 19th century, institutional reforms in France had made primary school education available to all children. As a result, French educators struggled to deliver a curriculum to students ranging from the very bright to those who found school exceptionally challenging. To respond to this problem, the French government wanted an objective way of identifying "retarded" children who would benefit from specialized education (Siegler, 1992).

Binet and Simon experimented with a wide variety of tasks, trying to capture the complex thinking processes that presumably comprised intelligence. They settled on 30 tasks, arranged in order of increasing difficulty. For example, simple tasks included repeating sentences and

defining common words like *house*. More difficult tasks included constructing sentences using combinations of certain words (e.g., Paris, river, fortune), reproducing drawings from memory, and being able to explain how two things differed from each other. Very difficult tasks included being able to define abstract concepts and to logically reason through a problem (Fancher, 1985).

Binet and Simon gave their test to samples of children from different age groups to establish the average test score for each age. Binet argued that a child's test score measured their **mental age**, *the average intellectual ability score for children of a specific age*. For example, if a seven-year-old's score was the same as the average score for seven-year-olds, they would have a mental age of seven, whereas if it was the same as the average score for 10-year-olds, they would have a mental age of 10, even though their chronological age would be seven in both cases. A child with a mental age lower than their chronological age would be expected to struggle in school and to require remedial education.

The practicality of Binet and Simon's test was apparent to others, and soon researchers in the United States began to adapt it for their own use. Lewis Terman at Stanford University adapted the test for American children and established average scores for each age level by administering the test to thousands of children. In 1916, he published the first version of his adapted test, and named it the Stanford-Binet Intelligence Scale (Siegler, 1992).

Terman and others almost immediately began describing the **Stanford-Binet test** as *a test intended to measure innate levels of intelligence*. This differed substantially from Binet, who had viewed his test as a measure of a child's current abilities, not as a measure of an innate capacity. There is a crucial difference between believing that test scores reflect a changeable ability or believing they reflect an innate capacity that is presumably

fixed. The interpretation of intelligence as an innate ability set the stage for the incredibly misguided use of intelligence tests in the decades that followed, as we discuss later in this module.

To better reflect people's presumably innate levels of intelligence, Terman adopted William Stern's concept of the **intelligence quotient or IQ**, a label that has stuck to the present day. *IQ is calculated by taking a person's mental age, dividing it by their chronological age, and then multiplying by 100*. For example, a 10-year-old child with a mental age of seven would have an IQ of 7/10 × 100 = 70. On the other hand, if a child's mental and chronological ages were the same, the IQ score would always be 100, regardless of the age of the child. Thus, 100 became the standard IQ for the "average child."

To see the conceptual difference implied by these two ways of reporting intelligence, consider the following two statements. Does one sound more optimistic than the other?

- He has a mental age of seven, so he is three years behind.
- He has an IQ of 70, so he is 30 points below average.

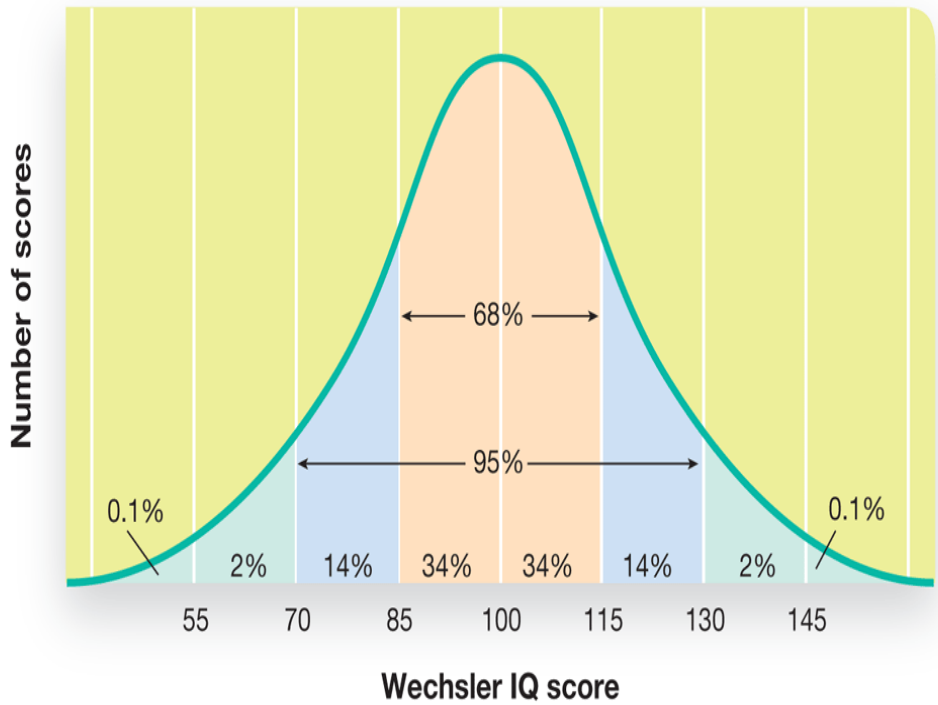
To many people, being three years behind in mental age seems changeable. With sufficient work and assistance, it feels like such a child should be able to catch up to his peers. On the other hand, having an IQ that's 30 points below average sounds like the diagnosis of a permanent condition. Such a person seems doomed to be "unintelligent" forever.

One other odd feature of both Binet's mental age concept and Stern's IQ was that they didn't generalize very well to adult populations. For example, are 80-year-old twice as intelligent as 40-year-olds? After all, an 80-year-old who was as intelligent as an average 40-year-old would have an IQ of 50 (40/80 × 100 = 50); clearly, this doesn't make sense. Similarly,

imagine a 30-year-old with a mental age of 30; her IQ would be 100. But in 10 years, when she was 40, if her mental age stayed at 30, she would have an IQ of only 75 ($30/40 \times 100 = 75$). Given that IQ scores remain constant after about age 16 (Eysenck, 1994), this would mean that adults get progressively less smart with every year that they age. Although children may sometimes think exactly this about their parents, their parents would clearly have a different opinion.

To adjust for this problem, psychologists began to use a different measure, *deviation IQ*, for calculating the IQ of adults (Wechsler, 1939). The **deviation IQ** *is calculated by comparing the person's test score with the average score for people of the same age*. In order to calculate deviation IQs, one must first establish the norm, or average, for a population. To do so, psychologists administer tests to huge numbers of people and use these scores to estimate the average for people of different ages. These averages are then used as baselines against which to compare a person. Because "average" is defined to be 100, a deviation IQ of 100 means that the person is average, whereas an IQ of 115 would mean that the person's IQ is above average (see Figure 9.1). One advantage of using deviation IQ scores is that it avoids the problem of IQ scores that consistently decline with age because scores are calculated relative to others of the same age.

Figure 9.1 The Normal Distribution of Scores for a Standardized Intelligence Test



Number of scores
68%
95%
0.1%
2%
14%
34%
34%
14%
2%
0.1%
55
70
85
100
115
130
145
Wechsler IQ score

The Wechsler Adult Intelligence Scale

Listen to the Audio

In an ironic twist, the **Wechsler Adult Intelligence Scale (WAIS)**, *the most common intelligence test in use today for adolescents and adults*, was developed by a man who himself had been labelled as “feeble minded” by intelligence tests after immigrating to the United States from Romania at the age of nine. David Wechsler originally developed the scale in 1955 and it is now in its fourth edition.

The WAIS provides a single IQ score for each test taker—the *Full Scale IQ*—but also breaks intelligence into a *General Ability Index* (GAI) and a *Cognitive Proficiency Index* (CPI), as shown in Figure 9.2. The GAI is computed from scores on the Verbal Comprehension and Perceptual Reasoning indices. These measures tap into an individual’s intellectual abilities, but without placing much emphasis on how fast they can solve problems and make decisions. The CPI, in contrast, is based on the Working Memory and Processing Speed indices. It is included in the Full Scale IQ category because greater working memory capacity and processing speed allow more cognitive resources to be devoted to reasoning and solving problems. Figure 9.3 shows some sample test items from the WAIS.

Figure 9.2 Subscales of the Wechsler Adult Intelligence Scale

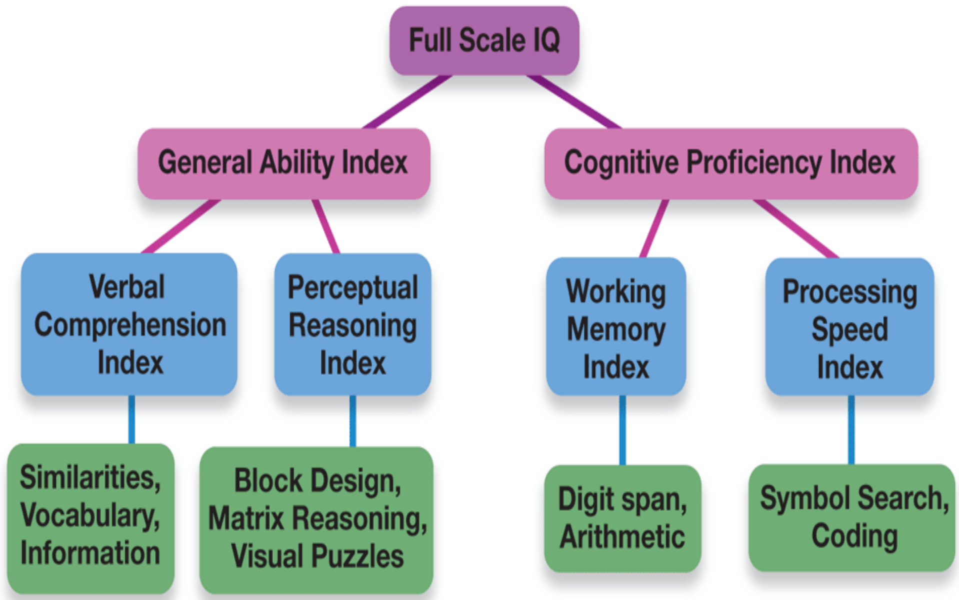


Figure 9.3 Types of Problems Used to Measure Intelligence

Click each panel below to reveal the types of problems used on the Wechsler Adult Intelligence Scale.

Processing Speed Index

Processing Speed Index	
Symbol search	View groupings of symbols for specific numbers of each symbol, and fill in a blank with a missing symbol.
Coding	Match different symbols with specific numbers, and fill in a blank with a correct symbol given a certain number.

Working Memory Index

Perceptual Reasoning Index

Block Design

Verbal Comprehension Index

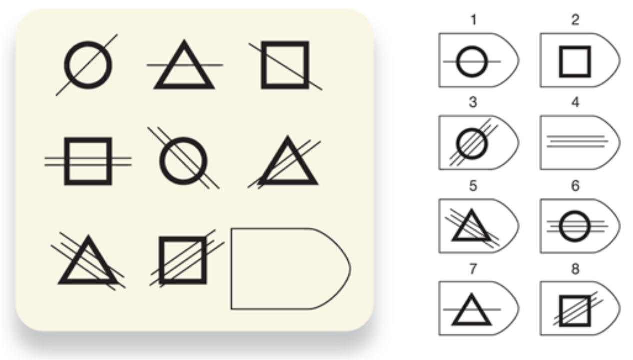
Raven’s Progressive Matrices

Listen to the Audio

Although the Stanford-Binet test and the WAIS have been widely used across North America, they have also been criticized by a number of researchers. One of the key problems with many intelligence tests, such as these, is that questions often are biased to favour people from the test developer’s culture or who primarily speak the test developer’s language. This cultural bias puts people from different cultures, social classes, educational levels, and primary languages at an immediate disadvantage. Clearly, this is a problem, because a person’s “intelligence” should not be affected by whether they are fluent in English or familiar with Western culture. In response to this problem, psychologists have tried to develop “culture-free” tests.

In the 1930s, John Raven developed **Raven’s Progressive Matrices**, *an intelligence test that is based on pictures, not words, thus making it relatively unaffected by language or cultural background*. The main set of tasks found in Raven’s Progressive Matrices measure the extent to which test takers can see patterns in the shapes and colours within a matrix and then determine which shape or colour would complete the pattern (see Figure 9.4).

Figure 9.4 Sample Problem from Raven's Progressive Matrices



Which possible pattern (from 1-8) should go in the blank space in the series? Once you've identified your choice, click Next to see the answer.

1 of 2 Previous Next

Source: "Sample Problem from Raven's Progressive Matrices," NCS Pearson, 1998.

The Checkered Past of Intelligence Testing

Listen to the Audio

IQ testing in North America got a significant boost during World War I. Lewis Terman, developer of the Stanford-Binet test, worked with the United States military to develop a set of intelligence tests that could be used to identify which military recruits had the potential to become officers and which should be streamed into non-officer roles. The intention was to make the officer selection process more objective, thereby increasing the efficiency and effectiveness of officer training programs. Following World War I, Terman argued for the use of intelligence tests in schools for similar purposes—identifying students who should be channelled into more advanced academic subjects that would prepare them for higher education, and others who should be channelled into more skill-based subjects that would prepare them for direct entry into the skilled trades and the general workforce. Armed with his purportedly objective IQ tests, he was a man on a mission to improve society. However, the way he went about doing so was rife with problems.

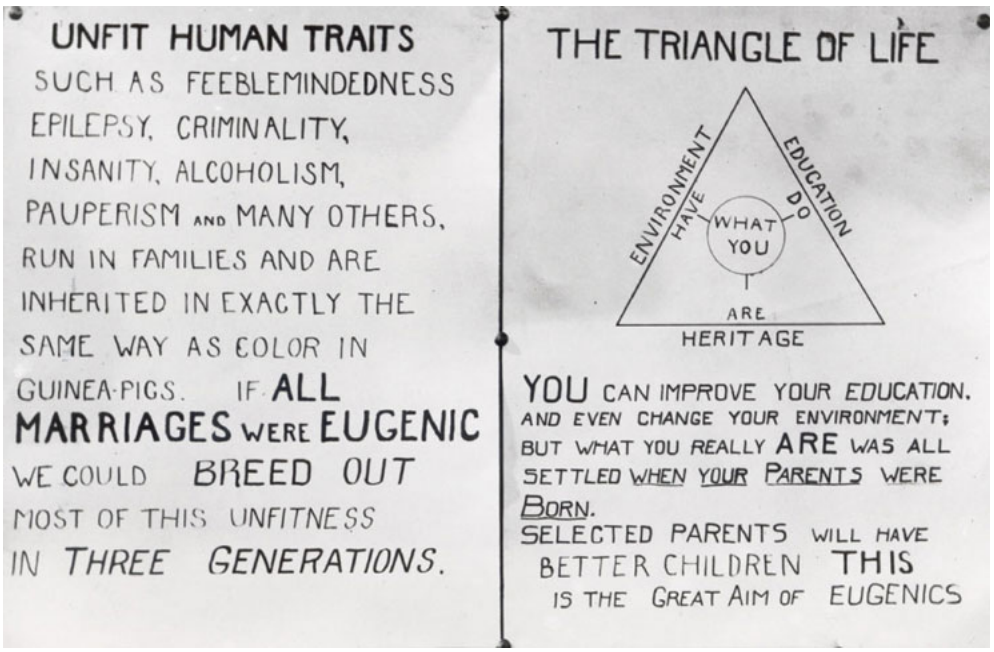
IQ Testing and the Eugenics Movement

Listen to the Audio

In order to understand the logic of Terman and his followers, it is important to examine the larger societal context in which his theories were developed. The end of the 19th and beginning of the 20th centuries was a remarkable time in human history. A few centuries of European colonialism had spread Western influence through much of the world. The Industrial Revolution, which was concentrated in the West, compounded this, making Western nations more powerful militarily, technologically, and economically. And in the sciences, Darwin's paradigm-shattering work on the origin of species firmly established the idea of evolution by natural selection (see Module 3.1), permanently transforming our scientific understanding of the living world.

Although an exciting time for the advancement of human knowledge, this confluence of events also had some very negative consequences, especially in terms of how colonialism affected non-Western cultures and people of non-white ethnicities. However, the stage was set for social "visionaries" to apply Darwin's ideas to human culture, and to explain the military–economic–technological dominance of Western cultures by assuming that Westerners (and especially white people) were genetically superior. This explanation served as a handy justification for the colonial powers' imposition of Western European values on other cultures. In fact, it was often viewed that the colonizers were actually doing other cultures a favour, helping to "civilize" them by assimilating them into a "superior" cultural system.

The *social Darwinism* that emerged gave rise to one of the uglier social movements of recent times—*eugenics*, which means "good genes" (Gillham, 2001). The history of eugenics is intimately intertwined with the history of intelligence testing. In fact, Francis Galton himself, a cousin of Charles Darwin, coined the term *eugenics*, gaining credibility for his ideas after making an extensive study of the heritability of intelligence.

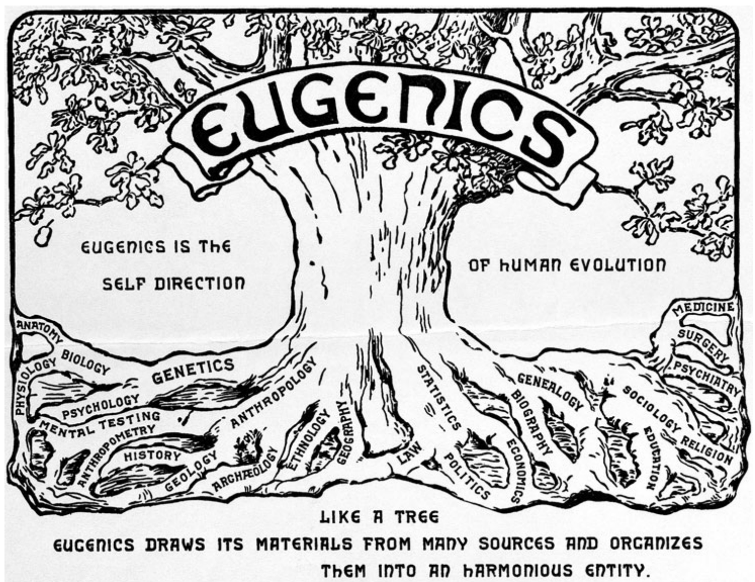


Many people viewed eugenics as a way to improve the human gene pool. Their definition of "improve" is certainly up for debate.

American Philosophical Society

Galton noticed that many members of his own family were successful businessmen and some, like Charles Darwin, eminent scientists. He studied other families and concluded that eminence ran in families, which he believed was due to "good breeding." Although families share more than genes, such as wealth, privilege, and social status, Galton believed that genes were the basis of the family patterns he observed (Fancher, 2009).

Galton's views influenced Lewis Terman, who promoted an explicitly eugenic philosophy. He argued for the superiority of his own "race" and, in the interest of "improving" society, believed that his IQ tests provided a strong empirical justification for eugenic practices. One such practice was the forced sterilization of people like Leilani Muir, whom we discussed at the beginning of this module.



Supporters of eugenics often noted that its logic was based on research and philosophy from many different fields. Doing so put the focus on the abstract intellectual characteristics of eugenics rather than on some of its disturbing, real-world implications.

American Philosophical Society

As Terman administered his tests to more people, it appeared that his race-based beliefs were verified by his data. Simply put, people from other cultures and other apparent ethnic backgrounds didn't score as highly on his tests as did white people from the West (i.e., the United States, Canada, and Western Europe, for the most part). For example, 40% of new immigrants to Canada and the United States scored so low they were classified as "feebleminded" (Kevles, 1985). As a result, Terman concluded that people from non-Western cultures and non-white

ethnicities generally had lower IQs, and he therefore argued that it was appropriate (even desirable) to stream them into less challenging academic pursuits and jobs of lower status. For example, he wrote,

> High-grade or border-line deficiency . . . is very, very common among Spanish-Indian and Mexican families of the Southwest and also among negroes. Their dullness seems to be racial, or at least inherent in the family stocks from which they come. . . . Children of this group should be segregated into separate classes. . . . They cannot master abstractions but they can often be made into efficient workers . . . from a eugenic point of view they constitute a grave problem because of their unusually prolific breeding. (Terman, 1916, pp. 91–92)

Such ideas gained enough popularity that forced sterilization was carried out in at least 30 of the United States and two Canadian provinces, lasting for almost half a century. In Alberta, the *Sexual Sterilization Act* remained in force until 1972, by which time more than 2800 people had undergone sterilization procedures in that province alone. And as you might have guessed, new immigrants, the poor, Indigenous people, and Black people were sterilized far more often than middle and upper-class White people.

The Race and IQ Controversy

Listen to the Audio

One of the reasons intelligence tests played so well into the agendas of eugenicists is that, from Terman onwards, researchers over the past century have consistently found differences in the IQ scores of people from different ethnic groups. Before we go any further, we want to acknowledge that this is a difficult, and potentially upsetting, set of research findings. However, it's important to take a close look at this research, and to understand the controversy that surrounds it, because these findings are well known in the world of intelligence testing and could be easily misused by those who are motivated by prejudiced views. As you will see, when you take a close look at the science, the story is not nearly as clear as it may appear at first glance.

The root of this issue about "race and IQ" is that there is a clear and reliable hierarchy of IQ scores across different ethnic groups. This was first discovered in the early 1900s, and by the 1920s, the United States passed legislation making it standard to administer intelligence tests to new immigrants arriving at Ellis Island for entry into the country. The result was that overwhelming numbers of immigrants were officially classified as feebleminded or as "morons," a normal, scientific term at that time. Although many, like Terman, automatically found genes to be the natural explanation, others kept a more open mind. Some psychologists suspected that these tests were unfair, and that the low scores of these minority groups might be due to language barriers and a lack of knowledge of American culture. Nevertheless, as intelligence tests were

developed that were increasingly culturally sensitive—such as Raven's Progressive Matrices—these differences persisted. Specifically, Asian people tended to score the highest, followed by whites, followed by Latinos and Blacks. This trend has been found in samples in several parts of the world, including Canada (Rushton & Jensen, 2005). Other researchers have found that Indigenous people in Canada score lower as a group than Canadians with European ancestry (e.g., Beiser & Gotowiec, 2000).

The race–IQ research hit the general public in 1994 with the publication of *The Bell Curve* (Herrnstein & Murray, 1994), which became a bestseller. This book focused on over two decades of research that replicated the race differences in IQ that we mentioned earlier. Herrnstein and Murray also argued that human intelligence is a strong predictor of many personal and social outcomes, such as workplace performance, income, and the likelihood of being involved in criminal activities. Additionally, *The Bell Curve* argued that those of high intelligence were reproducing less than those of low intelligence, leading to a dangerous population trend in the United States. They believed that America was becoming an increasingly divided society, populated by a small class of "cognitive elite," and a large underclass with lower intelligence. They argued that a healthy society would be a *meritocracy*, in which people who had the most ability and worked the hardest would receive the most wealth, power, and status. Those who didn't have what it took to rise to the top, such as those with low IQs, should be allowed to live out their fates, and should not therefore be helped by programs such as Head Start, affirmative action programs, or scholarships for members of visible minorities. Instead, the system should simply allow people with the most demonstrable merit to rise to the top, regardless of their cultural or ethnic backgrounds. Although many people agree with the idea of a meritocracy in principle, a huge problem arises in implementing a meritocracy when the system is set up to systematically give certain groups advantages over

other groups. In this situation, assessing true "merit" is far from straightforward.

As you can imagine, research on the race–IQ gap sparked bitter controversy. Within the academic world, some researchers have claimed that these findings are valid (e.g., Gottfredson, 2005), whereas others have argued that these results are based on flawed methodologies and poor measurements (e.g., Lieberman, 2001; Nisbett, 2005). Others have sought to discredit Herrnstein and Murray's conclusions, in particular their argument that the differences in IQ scores between ethnic groups means that there are inherent, genetic differences in intelligence between the groups. Within the general public, reaction was similarly mixed; however, this research does get used by some people to justify policies such as limiting immigration, discontinuing affirmative action programs, and otherwise working to overturn decades of progress made in the fight for civil rights and equality.

Problems with the Racial Superiority Interpretation

Listen to the Audio

In many ways, the simplest critique of the racial superiority interpretation of these test score differences is that the tests themselves are culturally biased. This critique was lodged against intelligence tests from the time of Terman and, as we discussed earlier, a considerable amount of research focused on creating tests that were not biased due to language and culture. But in spite of all this work, the test score differences between ethnic groups remained.

A more subtle critique was that it wasn't necessarily the tests that were biased, but the very process of testing itself. If people in minority groups are less familiar with standardized tests, if they are less motivated to do well on the tests, or if they are less able to focus on performing well during the testing sessions, they will be more likely to produce lower test scores. This indeed seems to be the case. Researchers have found that cultural background affects many aspects of the testing process, including how comfortable people are in a formal testing environment, how motivated they are to perform well on such tests, and their ability to establish rapport with the test administrators (Anastasi & Urbina, 1996).

Some research has also indicated that the IQ differences may be due to a process known as **stereotype threat**, which *occurs when negative stereotypes about a group cause group members to underperform on ability tests* (Steele, 1997). In other words, if a Black person is reminded of the

stereotype that Black people perform more poorly than white people on intelligence tests, they may end up scoring lower on that test as a result. Researchers have identified at least two reasons stereotype threat may lower scores:

- It increases physiological arousal—the kind of anxiety response that makes your palms sweaty and muscles tense.
- It causes people to pay much more attention to their own performance, which leaves less attention and memory available to focus on the test itself (Schmader et al., 2008).

There have now been more than 200 studies on stereotype threat (Nisbett et al., 2012). Critics of this concept say that many of the studies on stereotype threat have very small effects, and that the early studies are very difficult to replicate (Whaley, 2018).

These concerns cast doubt on the *validity* of IQ scores for members of non-white ethnic and cultural groups, suggesting that differences in test scores do not necessarily reflect differences in the underlying ability being tested (i.e., intelligence), but instead may reflect other factors, such as linguistic or cultural bias in the testing situation.

Another important critique has been lodged against the race–IQ research, arguing that even if one believes that the tests are valid and that there are intelligence differences between groups in society, these may not be the result of innate, genetic differences between the groups. For example, consider the circumstances that poor people and ethnic minorities face in countries like Canada or the United States. People from such groups tend to experience a host of factors that contribute to poorer cognitive and neurological development, such as poorer nutrition, greater stress, lower-quality schools, higher rates of illness (Acevedo-Garcia et al., 2008) with

reduced access to medical treatment, and greater exposure to toxins such as lead (Dilworth-Bart & Moore, 2006).

One additional, subtle factor that may interfere with the test performances of people from disadvantaged groups is that the life experiences of people in those groups may encourage them to adopt certain beliefs about themselves, which then interfere with their motivations to perform their best. For example, if early experiences in educational settings lead people to believe that they are not intelligent, and that this is a fixed quality, they will tend to believe that there is little they can do to change their own intelligence, and as a result, they won't try very hard to do so. However, recent research suggests that it *is* possible to improve one's intelligence—but one has to believe this in order to take the necessary steps to make it happen.

Working the Scientific Literacy Model

Beliefs about Intelligence

Listen to the Audio

Think of something you're not very good at (or maybe have never even tried), like juggling knives, solving Sudoku puzzles, or speaking Gaelic. Most likely, you would expect that even if your initial attempts didn't go well, with practice you could get better.

Now think about how smart you are. Do you think you could make yourself smarter? Do you ever say things like "I'm no good at math" or "I just can't do multiple choice tests?" Do you think about these abilities the same way that you think about knife-juggling?

Many people hold implicit beliefs that their intelligence level is relatively fixed and find it surprising that intelligence is, in fact, highly changeable. Ironically, this mistaken belief itself will tend to limit people's potential to change their own intelligence. This is an especially important issue for students, as children's self-perceptions of their mental abilities have a very strong influence on their academic performance (Greven et al., 2009).

What do we know about the kinds of beliefs that may affect test scores?

Research into this phenomenon has helped to shed light on the frustrating mystery of why some people seem to consistently fall short of reaching their potential. Carol Dweck (2002) has found

that people seem to hold one of two theories about the nature of intelligence. They may hold an **entity theory**: *the belief that intelligence is a fixed characteristic and relatively difficult (or impossible) to change;* or they may hold an **incremental theory**: *the belief that intelligence can be shaped by experiences, practice, and effort*. Whether a person holds to an entity theory or incremental theory has powerful effects on their academic performance.

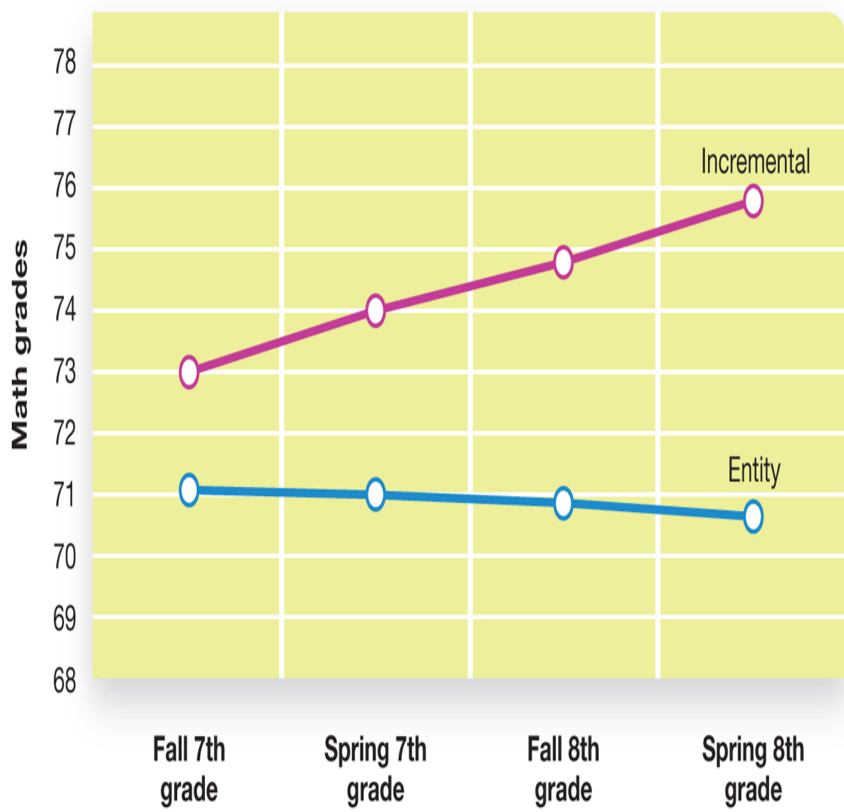
How can science test whether beliefs affect performance?

In experiments by Dweck and her colleagues, students were identified as holding either entity theory or incremental theory beliefs. The students had the chance to answer 476 general knowledge questions dealing with topics such as history, literature, math, and geography. They received immediate feedback on whether their answers were correct or incorrect. Those who held entity beliefs were more likely to give up in the face of highly challenging problems, and they were likely to withdraw from situations that resulted in failure. These individuals seemed to believe that intelligence was something you either had or you didn't. Thus, when encountering difficult problems or feelings of failure, they seemed to conclude, "Well, I guess I don't have it" and as a result gave up trying (Mangels et al., 2006).

In comparison, people with incremental views of intelligence were more resilient (Mangels et al., 2006), continuing to work hard even when faced with challenges and failures. After all, if intelligence and ability can change, then rather than getting discouraged by difficulties, one should keep working hard, improving one's abilities.

Because resilience is such a desirable trait, Dweck and her colleagues tested a group of junior high students to see whether incremental views could be taught (Blackwell et al., 2007). In a randomized, controlled experiment, they taught one group of grade 7 students incremental theory—that they could control and change their abilities. This group's grades increased over the school year, whereas the control group's grades actually declined (Figure 9.5).

Figure 9.5 Personal Beliefs Influence Grades



Students who held incremental views of intelligence (i.e., the belief that intelligence can change with effort) show improved grades in math compared to students who believed that intelligence was an unchanging entity (Blackwell et al., 2007).

Source: Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adult transition: A longitudinal study and an intervention. *Child Development*, *78*(1), Pg. 246–263.

The moral of the story? If you think you can, you might; but if you think you can't, you won't.

Can we critically evaluate this research?

These findings suggest that it is desirable to help people adopt incremental beliefs about their abilities. However, is this always for the best? What if, in some situations, it is true that no matter how hard a person tries, they are unlikely to succeed, and continuing to try at all costs may be detrimental to the person's well-being, or may close the door on other opportunities that may have turned out better? At what point do we encourage people to be more "realistic" and to accept their limitations? So far, these remain unanswered questions in this literature.

An additional difficulty surrounding these studies is that it is not fully clear what mechanisms might be causing the improvements. Does the incremental view of intelligence lead to increased attention, effort, and time invested in studying? Does it lead to less-critical self-judgments following failure experiences? Or does it have a positive effect on mood, which has been shown to improve performance on tests of perception and creativity (Isen et al., 1987)? In order to better understand why these mindsets work the way they do and, perhaps, how to apply them more effectively, a great deal of research is needed to determine which mechanisms are operating in which circumstances. However, regardless of the mechanism(s) involved, the fact that it is possible to help students by changing their view of intelligence could be a powerful force for educational change in the future.

Why is this relevant?

This research has huge potential to be applied in schools and to become a part of standard parenting practice. Teaching people to adopt the view that intelligence and other abilities are trainable

skills should give them a greater feeling of control over their lives, strengthen their motivations, enhance their resilience to difficulty, and improve their goal-striving success. Carol Dweck and Lisa Sorich Blackwell have designed a program called Brainology to teach students from elementary through high school that the brain can be trained and strengthened through practice. They hope that programs such as this can counteract the disempowering effects of stereotypes by helping members of stereotyped groups to have greater resilience and to avoid succumbing to negative beliefs about themselves. Not only is intelligence changeable, as this research shows, but perhaps society itself can be changed through the widespread application of this research.

Module 9.1 Summary

Listen to the Audio

9.1a Know . . . the key terminology associated with intelligence and intelligence testing.

Review Module 9.1

Start Over | Swap

0/11 REVIEWED · 0 MASTERED

stereotype threat

Previous | Next | Got It!

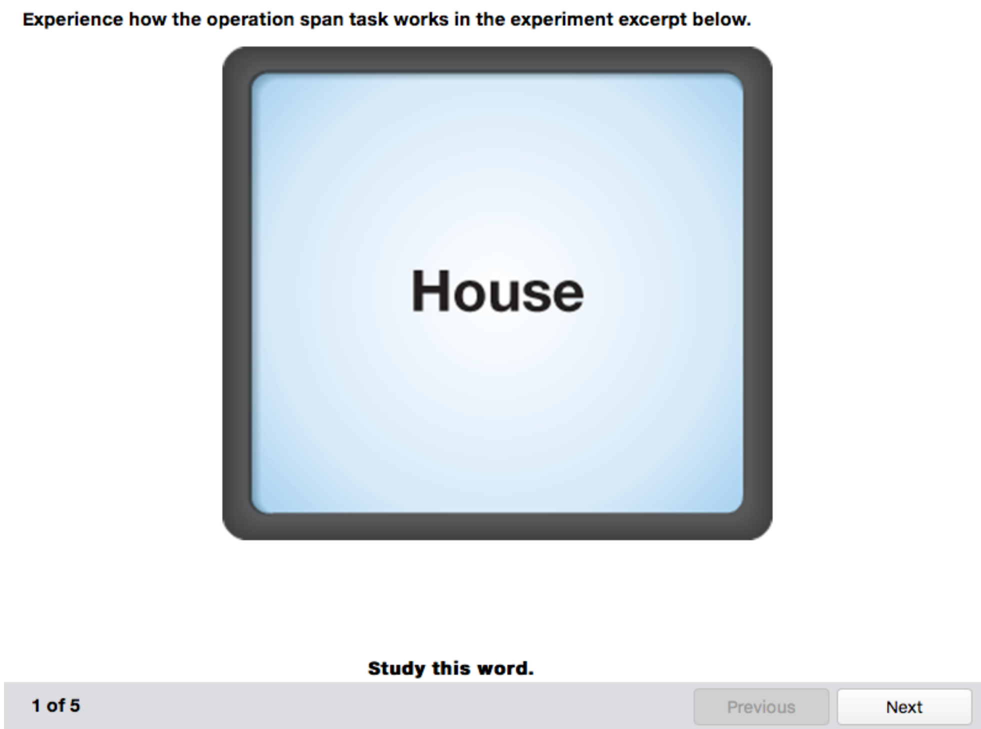
9.1b Understand . . . the reasoning behind the eugenics movements and its use of intelligence tests.

The eugenicists believed that abilities like intelligence were inborn, and thus, by encouraging reproduction between people with higher IQs, and reducing the birthrate of people with lower IQs, the gene pool of humankind could be improved.

9.1c Apply . . . the concepts of entity theory and incremental theory to help kids succeed in school.

One of the key reasons that people stop trying to succeed in school, and then eventually drop out, is that they hold a belief that their basic abilities, such as their intelligence, are fixed. Not trying then guarantees that they perform poorly, which reinforces their tendency to not try. However, this downward spiral can be stopped by training young people to think of themselves as changeable. Specifically, learning to think that the brain is like a muscle that can be strengthened through exercise leads people to improve their scores on intelligence tests, helps them become more resilient to negative circumstances, and enables them to respond to life's challenges more effectively.

Review A Memory Task for Measuring Intelligence



9.1d Analyze . . . why it is difficult to remove all cultural bias from intelligence testing.

There are many reasons why the process of intelligence testing may be systematically biased, resulting in inaccuracies when testing people from certain cultural groups: Tests may contain content that is more relevant or familiar to some cultures; the method of testing (e.g., paper-and-pencil multiple-choice questions) may be more familiar to people from some cultures; the environment of testing may make people from some cultures less comfortable; the presence of negative stereotypes about one's group may interfere with test-taking abilities; and the internalization of self-defeating beliefs may affect performance.

Module 9.2 Understanding Intelligence

Listen to the Audio

Lane V. Erickson/Shutterstock

Learning Objectives

9.2a Know . . . the key terminology related to understanding intelligence.

9.2b Understand . . . why intelligence is described as a hierarchy.

9.2c Understand . . . intelligence differences between males and females.

9.2d Apply . . . your knowledge to identify examples that reflect fluid vs. crystallized intelligence.

9.2e Analyze . . . whether teachers should spend time tailoring lessons to each individual student's learning style.

In 1849, Blind Tom was born into a slave family in the southern United States. When his mother was bought in a slave auction by General James Bethune, Tom was included in the sale for nothing because he was blind and believed to be useless. Indeed, Tom was not "smart" in the normal sense of the term. Even as an adult he could speak fewer than 100 words and would never be able to go to school. But he could play more than 7000 pieces on the piano, including a huge classical music repertoire and many of his own compositions. Tom could play, flawlessly, Beethoven, Mendelssohn, Bach, Chopin, Verdi, Rossini, and many others, even after hearing a piece only a single time. As an 11-year-old, he played at the White House, and by 16 went on a world tour. A panel of expert musicians performed a series of musical experiments on him, and universally agreed he was "among the most wonderful phenomena in musical history." Despite his dramatic linguistic limitations, he could reproduce, perfectly, up to a 15-minute conversation without losing a single syllable, and could do so in English, French, or German, without understanding any part of what

he was saying. In the mid-1800s, he was considered to be the "eighth wonder of the world."

Today, Tom would be considered a ***savant****, an individual with low mental capacity in most domains but extraordinary abilities in other specific areas such as music, mathematics, or art. The existence of savants complicates our discussion of intelligence considerably. Usually, the label "intelligent" or "unintelligent" is taken to indicate some sort of overall ability, the amount of raw brainpower available to the person, akin to an engine's horsepower. But this doesn't map onto savants at all—they have seemingly unlimited "horsepower" for certain skills and virtually none for many others. The existence of savants, and the more general phenomenon of people being good at some things (e.g., math, science) but not others (e.g., languages, art) challenges our understanding of intelligence and makes us ask more deeply, what is intelligence? Is it one ability? Or is it many?*

When we draw conclusions about someone's intelligence (e.g., Sally is really smart!), we intuitively know what we mean. Right? Being intelligent has to do with a person's abilities to think, understand, reason, learn, and find solutions to problems. But this intuitive understanding unravels quickly when you start considering the questions it raises. Are these abilities related to each other? Does the content of a person's intelligence matter? That is, does it mean the same thing if a person is very good at different things, like math, music, history, poetry, and childrearing? Or should intelligence be thought of more as a person's abilities on these specific types of tasks? Perhaps that would mean that there isn't any such thing as "intelligence" per se, but rather a whole host of narrower "intelligences." As you will learn in this module, a full picture of intelligence involves considering a variety of different perspectives.

Intelligence as a Single, General Ability

Listen to the Audio

When we say someone is intelligent, we usually are implying they have a high level of generalized cognitive ability. We expect intelligent people to be intelligent in many different ways, about many different topics. We wouldn't normally call someone intelligent if they were good at, say, making up limericks, but nothing else. Intelligence should manifest itself in many domains.

Scientific evidence for intelligence as a general ability dates back to early 20th-century work by Charles Spearman, who began by developing techniques to calculate correlations among multiple measures of mental abilities (Spearman, 1923). For example, imagine that scores on tests of vocabulary, reading comprehension, and verbal reasoning correlate highly together; these would form a factor we might refer to as verbal intelligence. Similarly, imagine that scores on algebra, geometry, and calculus questions correlate highly together; these would form a factor we might call numerical intelligence. However, if the language variables don't correlate very well with the math variables, then you have some confidence that these are separate factors. In this case, it would imply that there are at least two types of independent abilities: math and language abilities. For there to be an overarching general ability called intelligence, one would expect that tests of different types of abilities would all correlate with each other, forming only one factor.

Spearman's General Intelligence

Listen to the Audio

Spearman found that schoolchildren's grades in different school subjects were positively correlated, even though the content of the different topics (e.g., math vs. history) was very different. This led Spearman to hypothesize the existence of a **general intelligence factor** (abbreviated as "***g***"). Spearman believed that *g represented a person's "mental energy," reflecting his belief that some people's brains are simply more "powerful" than others* (Sternberg, 2003). This has greatly influenced psychologists up to the present day, cementing within the field the notion that *intelligence* is a basic cognitive trait comprising the ability to learn, reason, and solve problems, regardless of their nature. Common intelligence tests in use today calculate *g* as an "overall" measure of intelligence (Johnson et al., 2008).

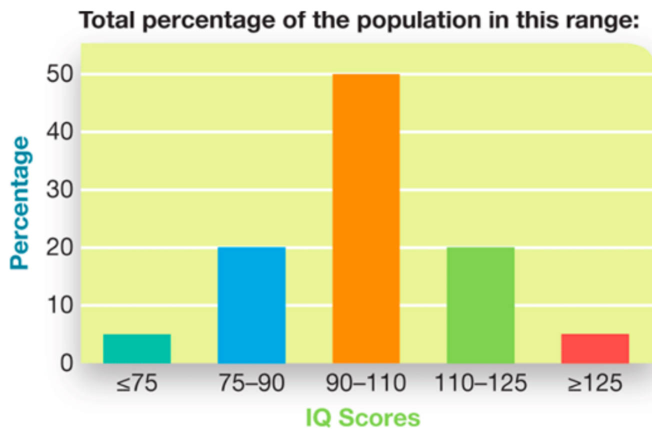
But is *g* real? Does it predict anything meaningful? In fact, *g* does predict many important phenomena. For example, *g* correlates quite highly with high school and university grades (Neisser et al., 1996), how many years a person will stay in school, and how much they will earn afterward (Ceci & Williams, 1997).

General intelligence scores also predict many seemingly unrelated phenomena, such as how long people are likely to live (Gottfredson & Deary, 2004), how quickly they can make snap judgments on perceptual discrimination tasks (i.e., laboratory tasks that test how quickly people form perceptions; Deary & Stough, 1996), and how well people can exert

self-control (Shamosh et al., 2008). Some other examples of *g*'s influences are depicted in Figure 9.6.

Figure 9.6 General Intelligence Is Related to Many Different Life Outcomes

Total Population



Divorced within 5 Years

Living in Poverty

Have Been Incarcerated

General intelligence (*g*) predicts not just intellectual ability, but also psychological well-being, income, and successful long-term relationships.

Source: Based on "General Intelligence is related to Various Outcomes" Adapted from Herrnstein, R., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American Life*. New York: Free Press; Gottsfredson, L. (1997). Why g matters: Complexity of everyday life. Intelligence, 24, 79-132.

In the workplace, intelligence test scores not only predict who gets hired, but also how well people perform at a wide variety of jobs. In fact, the correlation is so strong that after almost a century of research, general mental ability has emerged as one of the best overall predictors of

performance at work and in post-graduate education (Kuncel & Hezlett, 2010; Van Iddekenge et al., 2018). Overall intelligence is a far better predictor than the applicant's level of education (correlation = .10) or how well the applicant does in the job interview itself (correlation = .14). It is amazing to think that in order to make a good hiring decision, a manager would be better off using a single number given by an IQ test than actually sitting down and interviewing applicants face to face!

The usefulness of *g* is also shown by modern neuroscience research findings that overall intelligence predicts how well our brains work. For example, Tony Vernon at Western University and his colleagues have found that general intelligence test scores predict how efficiently we conduct impulses along nerve fibres and across synapses (Johnson et al., 2005; Reed et al., 2004). This efficiency of nerve conduction allows for more efficient information processing overall. As a result, when working on a task, the brains of highly intelligent people don't have to work as hard as those of less intelligent people. High IQ brains show less overall brain activation than others for the same task (Grabner et al., 2003; Haier et al., 1992).

Thus, overall intelligence, as indicated by *g*, is related to many real-world phenomena, from how well we do at work to how well our brains function.

Does *g* Tell Us the Whole Story?

Listen to the Audio

Clearly, *g* reflects a real statistical phenomenon: people who do well on one type of test tend to have good performance on many other tests. Although tests are abstract, they also tend to correlate with real-world factors like job performance. However, not everyone is convinced that the measures used really tell us anything more than some people tend to be able to solve problems better than others (Richardson & Norgate, 2015). Moreover, we have to remember that correlation does not equal causation. It is possible that the correlations between *g* and job performance are due to a third variable (perhaps motivation, self-confidence, or other variables) that lead people to do good work, whether it is on the job or when given a test. In fact, some research in the workplace has found that motivation is every bit as important as *g* (Van Iddekenge et al., 2018).

Finally, measures of *g* do not tell us much about how intelligence works, only whether people tend to do well on various types of tasks. As an analogy, consider ways of measuring the performance of an automobile. Some cars would get high marks for accelerating quickly, making sharp turns, and being able to zigzag without skidding. The fact that all of these performance indicators are correlated is not surprising—they are defining features of a sports car. However, the correlations tell us nothing about the feats of engineering and manufacturing that allow these characteristics to exist in the first place. Similarly, *g* only tells us that

certain types of performance tend to correlate, but those measures don’t say why.

So what can *g* explain about a person’s intelligence? How could a single number possibly capture the kinds of genius exhibited by savants like Blind Tom, who are exceptionally talented in some domains but severely impaired in others? It is easy to find other examples in your own experience. Surely, you have known people who were very talented in art or music but terrible in math or science? Or perhaps you have known an incredibly smart person who was socially awkward, or a charismatic and charming person whom you’d never want as your chemistry partner? There may be many ways of being intelligent, and reducing such diversity to a single number seems to overlook the different types of intelligence that people have.

Intelligence as Multiple, Specific Abilities

Listen to the Audio

Spearman himself believed that *g* didn't fully capture intelligence because his own analyses showed that although different items on an intelligence test were correlated with each other, their correlations were never 1.0, and usually far less than that. Thus, *g* cannot be the whole story; there must, at the very least, be other factors that account for the variability in how well people respond to different questions.

One possible explanation is that in addition to a generalized intelligence, people also possess a number of specific skills. Individual differences on these skills may explain some of the variability on intelligence tests that is not accounted for by *g*. In a flurry of creativity, Spearman chose the inspired name "*s*" to represent this specific-level, skill-based intelligence. His two-factor theory of intelligence was therefore comprised of *g* and *s*, where *g* represents a person's general, overarching intelligence and *s* represents a person's skill or ability level for a given task.

Nobody has seriously questioned the *s* part of Spearman's theory. Obviously, each task in life, from opening a coconut to solving calculus problems, requires abilities that are specific to the task. However, the concept of *g* has come under heavy fire throughout the intervening decades, leading to several theories of *multiple* intelligences.

The first influential theory of multiple intelligences was created by Louis Thurstone, who examined scores of general intelligence tests using factor analysis, and found seven clusters of what he termed *primary mental abilities*. Thurstone's seven factors were word fluency (the person's ability to produce language fluently), verbal comprehension, numeric abilities, spatial visualization, memory, perceptual speed, and reasoning (Thurstone, 1938). He argued that there was no meaningful *g*, but that intelligence needed to be understood at the level of these primary mental abilities that functioned independently of each other. However, Spearman (1939) fired back, arguing that Thurstone's seven primary mental abilities were in fact correlated with each other, suggesting that there was after all an overarching general intelligence.

A highly technical and statistical debate raged for several more decades between proponents of *g* and proponents of multiple intelligences, until it was eventually decided that both of them were right.

The Hierarchical Model of Intelligence

Listen to the Audio

The controversy was largely settled by the widespread adoption of hierarchical models that describe how some types of intelligence are "nested" within others in a similar manner to how, for example, a person is nested within her community, which may be nested within a city. The general hierarchical model describes how our lowest-level abilities (those relevant to a particular task, like Spearman's *s*) are nested within a middle level that roughly corresponds to Thurstone's primary mental abilities (although not necessarily the specific ones that Thurstone hypothesized), and these are nested within a general intelligence (Spearman's *g*; Gustaffson, 1988). By the mid-1990s, analyses of prior research on intelligence concluded that almost all intelligence studies were best explained by a three-level hierarchy (Carroll, 1993).

What this means is that we have an overarching general intelligence, which is made up of a small number of sub-abilities, each of which is made up of a large number of specific abilities that apply to individual tasks. However, even this didn't completely settle the debate about what intelligence really is, because it left open a great deal of room for different theories of the best way to describe the middle-level factors. And as you will see in the next section, even the debate about *g* has been updated in recent years.

Working the Scientific Literacy Model

Testing for Fluid and Crystallized Intelligence

Listen to the Audio

The concept of *g* implies that performance on all aspects of an intelligence test is influenced by this central ability. But careful analyses of many data sets, and recent neurobiological evidence, have shown that there may be two types of *g* that have come to be called fluid intelligence (Gf) and crystallized intelligence (Gc).

What do we know about fluid and crystallized intelligence?

The distinction between fluid and crystallized intelligence is basically the difference between "figuring things out" and "knowing what to do from past experience." **Fluid intelligence (Gf)** is *a type of intelligence used in learning new information and solving new problems not based on knowledge the person already possesses*. Tests of Gf involve problems such as pattern recognition and solving geometric puzzles, neither of which is heavily dependent on past experience. For example, Raven's Progressive Matrices, in which a person is asked to complete a series of geometric patterns of increasing complexity (see Module 9.1), is the most widely used measure of Gf. In contrast, **crystallized intelligence (Gc)** is *a type of intelligence that draws upon past learning and experience*. Tests of Gc, such as tests of vocabulary and general knowledge, depend heavily on

individuals' prior knowledge to come up with the correct answers (Figure 9.7; Cattell, 1971).

Figure 9.7 Fluid and Crystallized Intelligence

Fluid intelligence is dynamic and changing, and may eventually become crystallized into a more permanent form.

AVAVA/Shutterstock

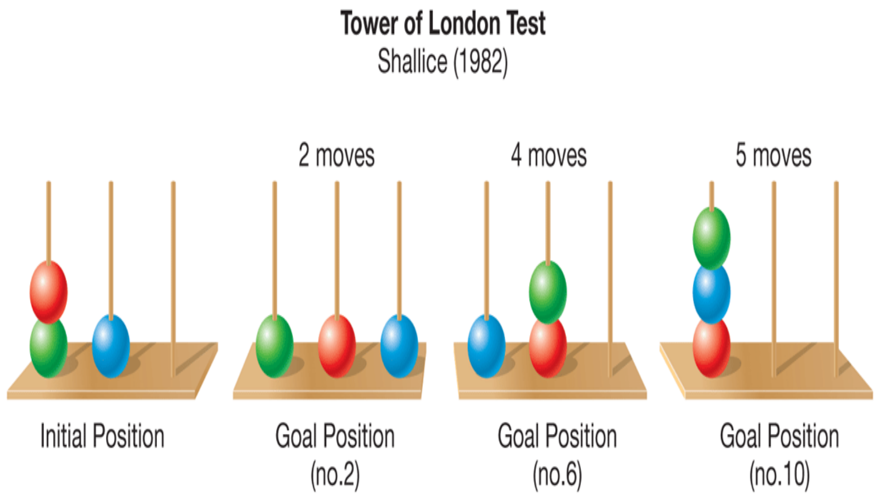
Gf and Gc are thought to be largely separate from each other, with two important exceptions. One is that having greater fluid

intelligence means that the person is better able to process information and to learn. Therefore, greater Gf may, over time, lead to greater Gc, as the person who processes more information will gain more crystallized knowledge (Horn & Cattell, 1967). Note, however, that this compelling hypothesis has received little empirical support thus far (Nisbett et al., 2012). The second is that it is difficult, perhaps impossible, to measure Gf without tapping into people's preexisting knowledge and experience, as we discuss below.

How can science help distinguish between fluid and crystallized intelligence?

One interesting line of research that supports the Gf/Gc distinction comes from examining how each type changes over the lifespan (Cattell, 1971; Horn & Cattell, 1967). In one study, people aged 20 to 89 years were given a wide array of tasks, including the Block Design task (see Figure 9.3), the Tower of London puzzle (see Figure 9.8), and tests of reaction time. Researchers have found that performance in Gf tasks declines after a certain age, which some research estimates as middle adulthood (Bugg et al., 2006), whereas other studies place the beginning of the decline as early as the end of adolescence (Avolio & Waldman, 1994; Baltes & Lindenberger, 1997). Measures of Gc (see Figure 9.9), by comparison, show greater stability as a person ages (Schaie, 1994). Healthy, older adults generally do not show much decline, if any, in their crystallized knowledge, at least until they reach their elderly years (Miller et al., 2009).

Figure 9.8 Measuring Fluid Intelligence



The Tower of London problem has several versions, each of which requires the test taker to plan and keep track of rules. For example, the task might involve moving the coloured beads from the initial position so that they match any of the various end goal positions.

Source: Shallice, T. (1982). Specific impairments of planning. *Philosophical Transcripts of the Royal Society of London, B 298*, 199–209. "Measuring Fluid Intelligence."

Figure 9.9 Measuring Crystallized Intelligence

Crystallized intelligence refers to facts, such as names of countries.

Neurobiological evidence further backs this up. The functioning of brain regions associated with Gf tasks declines sooner than the functioning of those regions supporting Gc tasks (Geake & Hansen, 2010). For example, the decline of Gf with age is associated with reduced efficiency in the prefrontal cortex (Braver & Barch, 2002), a key brain region involved in the cognitive abilities that underlie fluid intelligence (as discussed below). In contrast, this brain region does not play a central role in

crystallized intelligence, which is more dependent on long-term memory systems that involve a number of different regions of the cortex.

Can we critically evaluate crystallized and fluid intelligence?

There are certainly questions we can ask about crystallized and fluid intelligence. For one, is there really any such thing as fluid intelligence, or does it merely break down into specific sub-abilities?

Psychologists generally accept that fluid intelligence is a blending of multiple cognitive abilities. For example, the abilities to switch attention from one stimulus to another, inhibit distracting information from interfering with concentration, sustain attention on something at will, and keep multiple pieces of information in working memory at the same time are all part of fluid intelligence (Blair, 2006). If Gf is simply a statistical creation that reflects the integration of these different processes, perhaps researchers would be better off focusing their attention on these systems, rather than the more abstract construct Gf.

Another critique is that fluid and crystallized intelligence are not, after all, entirely separable. Consider the fact that crystallized intelligence involves not only possessing knowledge, but also being able to access that knowledge when it's needed. Fluid cognitive processes, and the brain areas that support them such as the prefrontal cortex, play important roles in both storing and retrieving crystallized knowledge from long-term memory (Ranganath et al., 2003).

Why is this relevant?

Recognizing the distinctiveness of Gf and Gc can help to reduce stereotypes and expectations about intelligence in older persons,

reminding people that although certain kinds of intelligence may decline with age, other types that rely on accumulated knowledge and wisdom may even increase as we get older (Kaufman, 2001). Also, research on fluid intelligence has helped psychologists to develop a much more detailed understanding of the full complement of cognitive processes that make up intelligence, and to devise tests that measure these processes more precisely.

Gardner’s Theory of Multiple Intelligences

Listen to the Audio

Debates about the interpretation of g has led to some diverse opinions about intelligence. Although the nested approach has by far the best evidence to support it, some researchers look for different approaches that may be more useful. Doing so is an important part of science: By challenging accepted beliefs, we can either strengthen the evidence of them or find some major weaknesses.

In one well-known attempt to challenge the concept of *g*, Howard Gardner proposed an elaborate theory of multiple intelligences. Gardner was inspired by specific cases, such as people who were savants (discussed in the introduction to this module), who had extraordinary abilities in limited domains, very poor abilities in many others, and low *g*. Gardner was also influenced by cases of people with brain damage, which indicated that some specific abilities could be dramatically affected while others remained intact (Gardner, 1983, 1999). He also noted that “normal people” (presumably, those of us who are not savants and also don’t have brain damage) differ widely in their abilities and talents, having a knack for some things but hopeless at others, which doesn’t fit the notion that intelligence is a single, overarching ability. In other words, the evidence for *g* shows that in general, people good at one kind of test are good at others. However, it is quite normal to find examples to the contrary. If there really is a single intelligence, how can we explain the disparities in these cases?

Based on his observations, Gardner proposed a theory of **multiple intelligences**, *a model claiming that there are seven (now updated to at least nine) different forms of intelligence, each independent from the others* (see Table 9.1). The first three types of intelligence in Table 9.1 should be familiar by now. These are the intellectual skills found in traditional intelligence tests such as the WAIS or Raven's Matrices. When you reach the fourth row of the table, however, you should notice a big difference—bodily intelligence is a completely new proposal. Think about what that might entail. We all know at least one person who is a skilled athlete in one sport, and who can almost instantly pick up any other sport. At the same time, we also know that person who can barely walk across a flat surface without tripping over their feet. Most of us, of course, are somewhere in the middle. Saying that people vary in physical skill is one thing, but Gardner is going beyond that. What others have called skill, he considers intelligence.

Table 9.1 Gardner's Proposed Forms of Intelligence

Table 9.1 Gardner's Proposed Forms of Intelligence

Verbal/linguistic intelligence	The ability to read, write, and speak effectively
Logical/mathematical intelligence	The ability to think with numbers and use abstract thought; the ability to use logic or mathematical operations to solve problems
Visuospatial intelligence	The ability to create mental pictures, manipulate them in the imagination, and use them to solve problems
Bodily/kinesthetic intelligence	The ability to control body movements, to balance, and to sense how the body is situated
Musical/rhythmical intelligence	The ability to produce and comprehend tonal and rhythmic patterns
Interpersonal intelligence	The ability to detect another person's emotional states, motives, and thoughts
Self/intrapersonal intelligence	Self-awareness; the ability to accurately judge your own abilities, and identify your own emotions and motives
Naturalist intelligence	The ability to recognize and identify processes in the natural world—plants, animals, and so on
Existential intelligence	The tendency and ability to ask questions about purpose in life and the meaning of human existence

Source: The Nine Types of Intelligence by Gardner, H. (2006). *Multiple Intelligences: New Horizons in Theory and Practice*. New York: Basic Books.

As intuitively appealing as this is, critics have pointed out that few of Gardner's intelligences can be accurately and reliably measured, making his theory unfalsifiable and difficult to research. For example, how would you reliably measure "existential intelligence" or "bodily/kinesthetic intelligence"? You cannot simply ask people how existential they are, or how well they are able to attune to their bodies, relative to other people. Creating operational definitions of these concepts has proven to be a difficult challenge and has held back empirical work on Gardner's theory. This is not a critique against Gardner specifically, but rather, highlights the need for researchers to develop better ways of measuring intelligence (Tirri & Nokelainen, 2008).

Myths in Mind

Learning Styles

If there is one single myth that vexes the most cognitive psychologists to the greatest degree, it is the widespread belief that people have individualized learning styles. As the myth goes, people process information better through specific modalities, such as sight, hearing, and bodily movement. If this is true, then it suggests that people have different learning styles (e.g., people may be visual learners, auditory learners, tactile learners, etc.), and therefore, educators would be more effective if they tailor their lesson plans to the learning styles of their students.

Such an idea sounds nice. It recognizes that individuals are unique and special in many ways, and it ties into proposals about multiple forms of intelligence. However, finding evidence

to support this theory has proven difficult. In fact, dozens of studies have failed to show any benefit for tailoring information to an individual's apparent learning style (Pasher et al., 2008). This result probably reflects the fact that regardless of how you encounter information—through reading, watching, listening, or moving around—retaining it over the long term largely depends on how deeply you process and store the *meaning* of the information (Willingham, 2004). If you need to know the location and geographical context of Senegal, for example, a visual presentation with some explanation is probably best for all students—learning styles have nothing to do with it. As a result, rather than trying to match the way that information is presented to the presumed learning styles of students, it is likely far more important for teachers to be able to engage students in ways they find interesting, meaningful, fun, personally relevant, and experientially engaging.

Gardner's theory has not had a large impact in psychology in the more than 30 years since its initial proposal. It rarely appears in scientific literature, although we include it in this chapter because it exerts some influence in applied fields, such as education. Critics rightly point to the lack of reliable ways of measuring Gardner's different intelligences and, as we hope you recall from Chapter 2, scientific ideas must be observable and testable. It is equally important to have operational definitions of scientific constructs, and critics of multiple intelligences sometimes claim that it simply means "to be good at something." In other words, mainstream psychology describes intelligence as "good at cognitive tasks" whereas multiple intelligence theory really only adds "good at physical movements," "good at working with other people," and so on. From the applied perspective, Gardner's theory is useful in that it reminds teachers to connect with and motivate students with different

strengths. It helps people to see themselves as capable in different ways, rather than feeling limited by their IQ score, especially if it is not very high. And it reminds us to appreciate the wide range of human abilities and accomplishments far better than a mere IQ score.

Psych@

The NHL

For some reason, many of us enjoy participating in or watching activities that put the brain at high risk for injury. Take hockey, for example. Despite wearing head protection, players still suffer head injuries from collisions with each other, running into the boards, getting punched in the face, and landing on the ice. Although the NHL does not release precise medical statistics (citing players' privacy), researchers have been able to estimate the rate of concussions at about 80 per season (Wennberg & Tator, 2003; Wennberg & Tator, 2008) with countless less severe knocks and bumps every game. All of these can add up over time, leading to Chronic Traumatic Encephalopathy (CTE), a degenerative brain condition associated with memory loss, dementia, mood disorders, and suicidality. CTE is a devastating condition, and the NHL recently filed a legal settlement with over 300 former players to fund medical treatment and prevention efforts.

So how does intelligence testing fit in? First, you should know that CTE develops over time rather than after a single brain injury. Early detection would allow players and medical personnel to make smarter, more informed decisions about when and if to return to the sport, thus reducing the additive effect of further injury. Unfortunately, the severity of a head

injury is not that easy to diagnose either on the bench or at a clinic the day after the game. Furthermore, you can't just give a cognitive test to a player after a hit and find out what has changed; you need to know where that individual's abilities were to start with. Therefore, many sports leagues and teams now require *baseline cognitive testing*. NHL players complete baseline testing with a computer-based testing package called ImPACT. In fact, if you play on one of your university's teams, you may already be familiar with this test.

Once each year, usually preceding the beginning of pre-season training, players will complete a cognitive exam to measure various intellectual abilities. Whereas intelligence tests provide dozens of small tasks that can be combined to estimate comprehensive scores such as g, verbal ability, or mathematical ability, sports testing keeps the tests separate. This is because head injuries tend to affect only a few cognitive skills, not *g*, so players complete tests of judgment, memory, perception, and response, times among other skills. Following a head injury, players can be tested again to see if there are declines in any of these specific abilities, even if an overall score like *g* would not reflect much change. If there is a significant drop in a narrow set of scores, there is a good chance that the brain has suffered a significant injury and players should not return to play.

Although baseline testing by itself won't reduce concussions, it does make the detection of significant brain injury more effective. By facilitating full recovery and reducing re-injury, sports teams will hopefully be able to prevent CTE.

In the 1990s, NHL player Todd Ewen was known for getting into at least one fistfight in virtually every game of his 11 seasons. The repeated fighting likely added to the normal bumps experienced in hockey. After retirement, he began acting hostile, depressed, and disoriented—all signs of CTE—and took his own life when he was in his 40s.

MIGUEL MEDINA/Stringer/AFP/Getty Images

The Battle of the Sexes

Listen to the Audio

The distinction between *g* and multiple intelligences plays an important role in the oft-asked question, “Who is smarter, females or males?” Although earlier studies showed some average intelligence differences between males and females, this finding has not been upheld by subsequent research and is likely the result of bias in the tests that favoured males over females. One of the most conclusive studies used 42 different tests of mental abilities to compare males and females and found almost no differences in intelligence between the sexes (Johnson & Bouchard, 2007).

Some research has found that although males and females have the same average IQ score, there is much greater variability in male scores; there are more men with substantial intellectual challenges, as well as more men who score at the very highest levels (Deary et al., 2007; Dykiert et al., 2009). However, before you assume these facts reflect innate biological difference between the sexes, you should know that things are not as simple as they first appear. For example, one type of test that shows this male advantage at the upper levels of ability examines math skills on standardized tests. A few decades ago, about 12 times more males than females scored at the very top (Benbow & Stanley, 1983). This difference has decreased in recent years to three to four times as many males scoring at the top end of the spectrum. Not surprisingly, this change has occurred just as the number of math courses being taken by females—and the efforts made to increase female enrollment in such

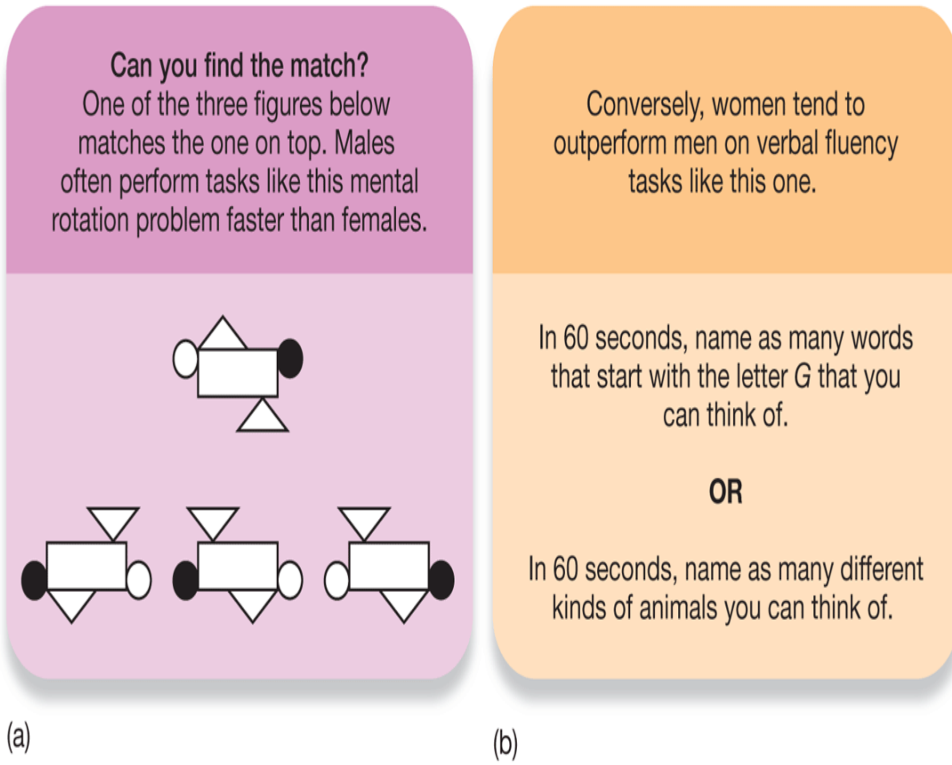
courses—has increased. So, the difference in results between the sexes is still there, but has been vastly reduced as a result of sociocultural changes, such as making math education more accessible for females (Wai et al., 2010). This trend may continue, and there seems to be no reason why females won’t outperform males, on average, at some point in the near future.

Do Males and Females Have Unique Cognitive Skills?

Listen to the Audio

Although the results discussed above suggest that males and females are equally intelligent, when multiple intelligences are considered, rather than overall IQ, a clear difference between the sexes does emerge. Females are, on average, better at verbal abilities, some memory tasks, and the ability to read people's basic emotions, whereas males have the advantage on visuospatial abilities, such as mentally rotating objects or aiming at objects (see Figure 9.10; Halpern & LaMay, 2000; Johnson & Bouchard, 2007; Tottenham et al., 2005; Weiss et al., 2003).

Figure 9.10 Mental Rotation and Verbal Fluency Tasks



Some research indicates that, on average, males outperform females on mental rotation tasks (a), while females outperform men on verbal fluency (b).

This finding is frequently offered as an explanation for why males are more represented in fields like engineering, science, and mathematics. However, there are many other factors that could explain the under-representation of women in these disciplines, such as prevalent stereotypes that discourage girls from entering the maths and sciences, parents from supporting them in doing so, and teachers from evaluating females' work without bias.

Overlooking the many other factors that limit females' participation in the maths and sciences is a dangerous thing to do. This was dramatically shown in 2005 when the President of Harvard University, Lawrence Summers, was removed from his position shortly after making a speech in which he argued that innate differences between the sexes may be

responsible for under-representation of women in science and engineering. The outrage many expressed at his comments reflected the fact that many people realize that highlighting innate differences while minimizing or ignoring systemic factors only serves to perpetuate problems, not solve them.

Module 9.2 Summary

Listen to the Audio

9.2a Know . . . the key terminology related to understanding intelligence.

Review Module 9.2

Start Over Swap

0/5 REVIEWED · 0 MASTERED

general intelligence factor (g)

Previous Next Got It!

9.2b Understand . . . why intelligence is divided into fluid and crystallized types.

Mental abilities encompass both the amount of knowledge accumulated and the ability to solve new problems. This understanding is consistent

not only with our common views of intelligence, but also with the results of decades of intelligence testing. Also, the observation that fluid intelligence can decline over the lifespan, even as crystallized intelligence remains constant, lends further support to the contention that they are different abilities.

9.2c Understand . . . intelligence differences between males and females.

Males and females generally show equal levels of overall intelligence, as measured by standard intelligence tests. However, men do outperform women on some tasks, particularly spatial tasks such as mentally rotating objects, whereas women outperform men on other tasks, such as perceiving emotions. Although there are some male–female differences in specific abilities, such as math, it is not yet clear whether these reflect innate differences between the sexes or whether other factors are responsible, such as reduced enrollment of women in math classes and the presence of stereotype threat in testing sessions.

9.2d Apply . . . . your knowledge to identify examples that reflect fluid vs. crystallized intelligence.

This distinction distinguishes between accumulated knowledge over time (crystallized) and the ability to learn and use new information and skill (fluid).

Apply Activity

Classify whether each indvidual's behaviour below is a better example of crystalized vs. fluid intelligence.

Behaviour	Type of Intelligence
Katrina is a young chemist working for a manufacturing company. Her senior employees are impressed by the way she can solve new problems in such innovative ways.	
Ahmed is Katrina's supervisor. He really appreciates her approach to solving problems but also is proud to share his extensive experience. Ahmed is demonstrating...	
Will has been doing challenging crossword puzzles for years. He finds that he is now able to complete complex puzzles more accurately and faster than before. Will claims that he has discovered specific tricks over the years that make solutions easier to find.	

Crystal

Start Over

9.2e Analyze . . . whether teachers should spend time tailoring lessons to each individual student's learning style.

Certainly, no one would want to discourage teachers from being attentive to the unique characteristics that each student brings to the classroom. However, large-scale reviews of research suggest that there is little basis for individualized teaching based on learning styles (e.g., auditory, visual, kinesthetic).

Module 9.3 Biological, Environmental, and Behavioural Influences on Intelligence

Listen to the Audio

MIGUEL MEDINA/Stringer/AFP/Getty Images

Learning Objectives

9.3a Know . . . the key terminology related to heredity, environment, and intelligence.

9.3b Understand . . . different approaches to studying the genetic basis of intelligence.

9.3c Apply . . . your knowledge of environmental and behavioural effects on intelligence to understand how to enhance your own cognitive abilities.

9.3d Analyze . . . the belief that older children are more intelligent than their younger siblings.

In 1955, the world lost one of the most brilliant scientists in history: Albert Einstein. Although you are probably familiar with his greatest scientific achievements, you may not know about what happened to him after he died—or, more specifically, what happened to his brain.

Upon his death, a forward-thinking pathologist, Dr. Thomas Harvey, removed Einstein's brain (his body was later cremated) so that it could be studied in the hope that medical scientists would eventually unlock the secret to his genius. Dr. Harvey took photographs of Einstein's brain, and then it was sliced up into hundreds of tissue samples placed on microscope slides, and 240 larger blocks of brain matter, which were preserved in fluid. Surprisingly, Dr. Harvey concluded that the brain wasn't at all remarkable, except for being smaller than average (1230 g, compared to the average of 1300 to 1400 g).

You might expect that Einstein's brain was intensively studied by leading neurologists. But, instead, the brain mysteriously disappeared. Twenty-two years later, a journalist named Steven Levy tried to find

Einstein's brain. The search was fruitless until Levy tracked down Dr. Harvey in Wichita, Kansas, and interviewed him in his office. Dr. Harvey was initially reluctant to tell Levy anything about the brain, but eventually admitted that he still had it. In fact, he kept it right there in his office! Sheepishly, Dr. Harvey opened a box labelled "Costa Cider" and there, inside two large jars, floated the chunks of Einstein's brain. Levy later wrote, "My eyes were fixed upon that jar as I tried to comprehend that these pieces of gunk bobbing up and down had caused a revolution in physics and quite possibly changed the course of civilization. Swirling in formaldehyde was the power of the smashed atom, the mystery of the universe's black holes, the utter miracle of human achievement" (Levy, 2015).

Since that time, several research teams have discovered important abnormalities in Einstein's brain. Einstein had a higher than normal ratio of glial cells to neurons in the left parietal lobe (Diamond et al., 1985) and parts of the temporal lobes (Kigar et al., 1997), and a higher density of neurons in the right frontal lobe (Anderson & Harvey, 1996). Einstein's parietal lobe has been shown to be about 15% larger than average, and to contain an extra fold (Witelson et al., 1999). The frontal lobes contain extra convolutions (folds and creases) as well. These extra folds increase the surface area and neural connectivity in those areas.

How might these unique features have affected Einstein's intelligence? The frontal lobes are heavily involved in abstract thought, and the parietal lobes are involved in spatial processing, which plays a substantial role in mathematics. Thus, these unique brain features may provide a key part of the neuroanatomical explanation for Einstein's remarkable abilities in math and physics. Einstein not only had a unique mind, but a unique brain.

Wouldn't it be wonderful to be as smart as Einstein? Or even just smarter than you already are? Imagine if you could boost your IQ, upgrading your

brain like you might upgrade a hard drive. You could learn more easily, think faster, and remember more. What benefits might you enjoy? Greater success? A cure for cancer? A Nobel Prize? At least you might not have to study as much to get good grades. As you will read in this module, there are in fact ways to improve your intelligence (although perhaps not to "Einsteinian" levels). However, to understand how these techniques can benefit us, we must also understand how our biology and our environment—nature and nurture—interact to influence intelligence.

Biological Influences on Intelligence

Listen to the Audio

The story of Einstein's brain shows us, once again, that our behaviours and abilities are linked to our biology. However, although scientists have been interested in these topics for over 100 years, we are only beginning to understand the complex processes that influence measures like IQ scores. In this section, we discuss the genetic and neural factors that influence intelligence, and how they may interact with our environment.

The Genetics of Intelligence: Twin and Adoption Studies

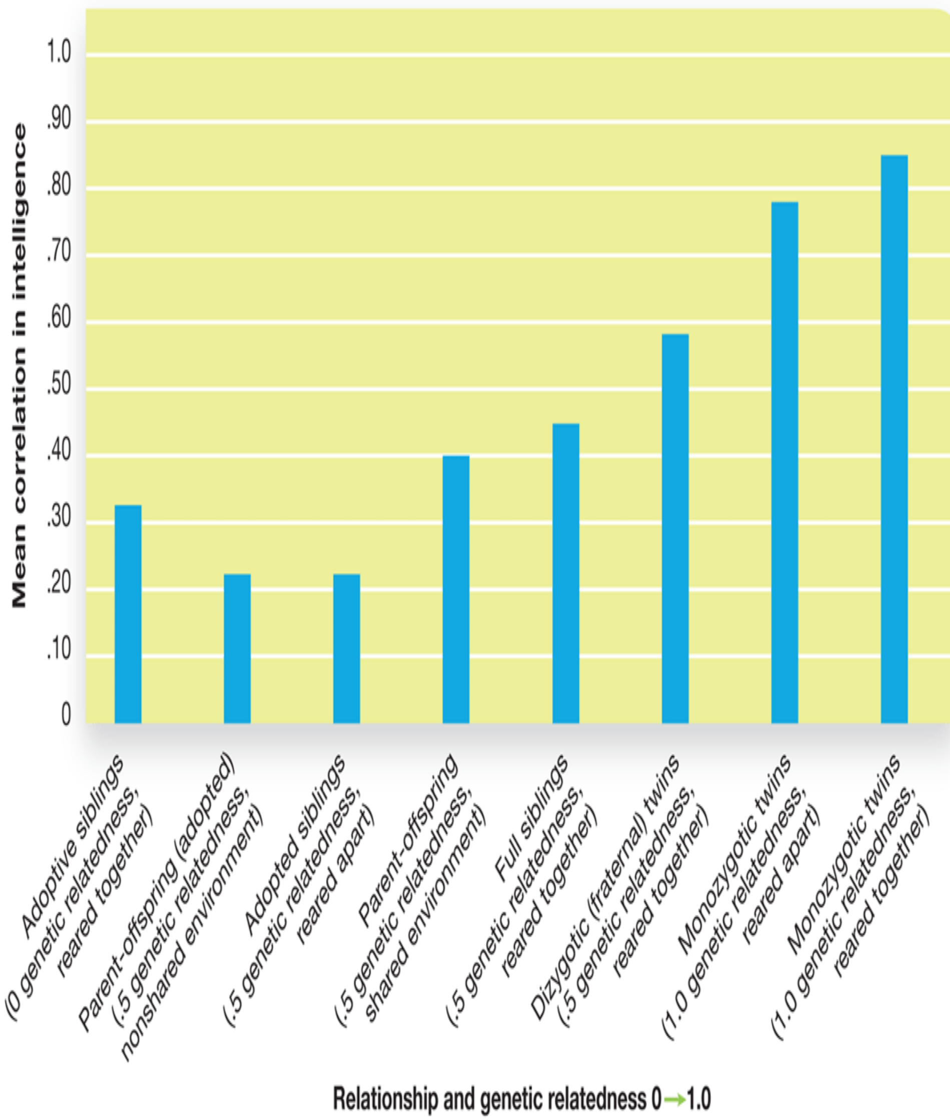
Listen to the Audio

The belief that intelligence is a capacity that we are born with has been widely held since the early studies of intelligence. However, early researchers lacked today's sophisticated methods for studying genetic influences, so they had to rely upon their observations of whether intelligence ran in families, which it seemed to do (see Module 9.1).
Since those early days, many studies have been conducted to see just how large the genetic influence on intelligence may be.

Studies of twins and children who have been adopted have been key tools, allowing researchers to begin estimating the genetic contribution to intelligence. Decades of such research have shown that genetic similarity does contribute to intelligence test scores. Several important findings from this line of study are summarized in Figure 9.11 (Plomin & Spinath, 2004). The most obvious trend in the figure shows that as the degree of genetic relatedness increases, similarity in IQ scores also increases. The last two bars on the right of Figure 9.11 present perhaps the strongest evidence for a genetic basis for intelligence. The intelligence scores of identical twins correlate with each other at about .85 when they are raised in the same home, which is much higher than the correlation for fraternal twins. Even when identical twins are adopted and raised apart, their intelligence scores are still correlated at approximately .80—a very strong relationship. In fact, this is about the same correlation that

researchers find when individuals take the same intelligence test twice and are compared with themselves!

Figure 9.11 Intelligence and Genetic Relatedness



Several types of comparisons reveal genetic contributions to intelligence (Plomin & Spinath, 2004). Generally, the closer the biological relationship between people, the more similar their intelligence scores.

Source: Adapted from Plomin, R., & Spinath, F. M. (2004). Intelligence: Genetics, genes, and genomics. *Journal of Personality & Social Psychology*, *86*(1), 112–129.

The Heritability of Intelligence

Listen to the Audio

Overall, the heritability of intelligence is estimated to be between 40% and 80% (Nisbett et al., 2012). However, interpreting what this means is extremely tricky. People often think that this means 40% or more of a person's intelligence is determined by genes, but this is a serious misunderstanding of heritability. Estimates of heritability represent how much of the differences between people in a *single sample* can be accounted for by differences in their genes (see Module 3.1). This means that a heritability estimate is not a single, fixed number for all humans. Instead, it is a number that *depends on the sample of people being studied*. Heritability estimates for different samples can be very different. For example, the heritability of intelligence for wealthy people has been estimated to be about 72%, but for people living in poverty, it's only 10% (Turkheimer et al., 2003). Why might this be?

The key to solving this puzzle is to recognize that heritability estimates depend on other factors, such as how different or similar people's environments are. If people in a sample inhabit highly similar environments, the heritability estimate will almost certainly be higher—there will be fewer environmental differences to influence the emergence of cognitive ability. Even if children live in very different geographical areas, the parents and communities have the resources to provide quality nutrition, housing, and schools. There are highly educated role models and parents have more time and resources to provide direct support. These factors contribute fairly equally to the intelligence of wealthy

people. Thus, differences in their intelligence scores are largely explained by genetic differences.

In contrast, when looking at impoverished environments, the heritability estimate will be lower because there are so many outside factors that influence IQ. For example, North American children growing up in low-income rural areas have higher verbal ability scores on average when compared to urban peers. Meanwhile, low-income children from the city tend to score higher on visual working memory tests. One hypothesis for these differences is that urban life features significant noise pollution, which, in other studies, has been shown to be detrimental to verbal ability. Meanwhile, the complex, constantly changing visual stimuli in the city require constant attention, so urban children exercise those abilities more (Tine, 2014).

There are many other problems with interpreting heritability estimates as indications that genes *cause* differences in intelligence. Two of the most important both have to do with an under-appreciation for how genes interact with the environment. First, as discussed in Module 3.1, genes do not operate in isolation from the environment. We know now that the "nature vs. nurture" debate has evolved into a discussion of how "nurture shapes nature." Environmental factors determine how genes express themselves and influence the organism.

Second, genes that influence intelligence may do so indirectly, operating through other factors. For example, imagine genes that promote novelty-seeking. People with these genes would be more likely to expose themselves to new ideas and new ways of doing things. This tendency to explore, rooted in their genes, may lead them to become more intelligent. However, in more dangerous environments, these novelty-seeking genes could expose the person to more danger. Therefore, genes that encourage exploratory behaviour might be related to higher intelligence in relatively

safe environments, but in dangerous environments might be related to getting eaten by cave-bears more often.

Behavioural Genomics

Listen to the Audio

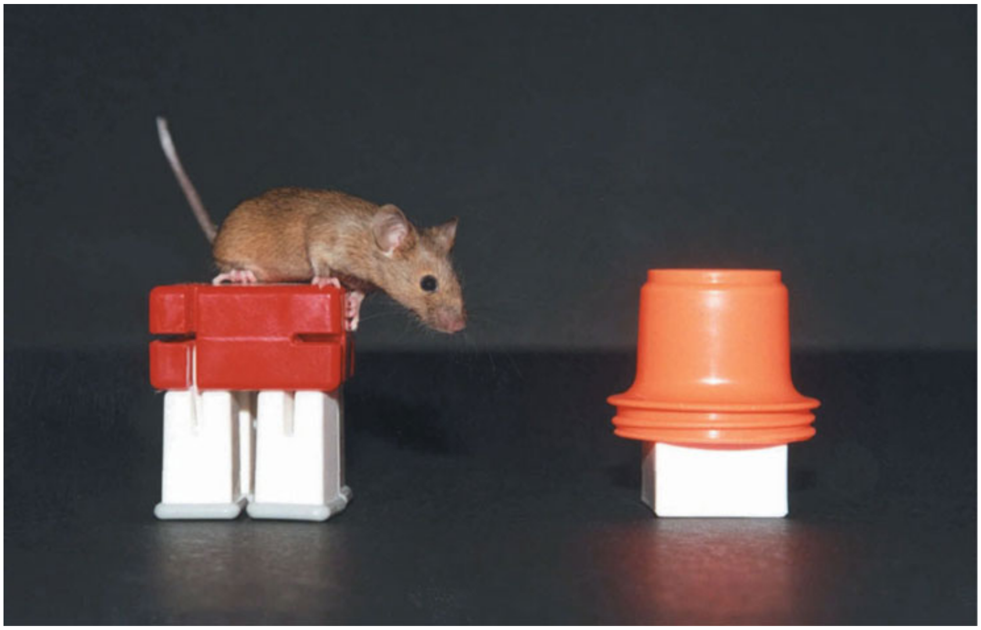
Twin and adoption studies show that some of the individual differences observed in intelligence scores can be attributed to genetic factors. But these studies do not tell us which genes account for the differences. To answer that question, researchers use *behavioural genomics*, a technique that examines how specific genes interact with the environment to influence behaviours, including those related to intelligence. Thus far, the main focus of the behavioural genomics approach to intelligence is to identify genes that are related to cognitive abilities, such as learning and problem solving (Deary et al., 2010).

Overall, studies scanning the whole human genome show that intelligence levels can be predicted, to some degree, by the collection of genes that individuals inherit (Craig & Plomin, 2006; Plomin & Spinath, 2004). Thanks to increasingly sophisticated research techniques, researchers have uncovered over 50 genes that covary with intelligence test scores (Sniekers et al., 2017). These collections of genes seem to pool together to influence general cognitive ability; although each contributes a small amount, the contributions combine to have a larger effect. Of course, finding these correlations does not explain how these genes influence intelligence, but a number of the genes have been shown to contribute to nerve cell development. Thus, there is still a long way to go before we can say that we understand the genetic contributors to intelligence.

One way of speeding the research up has been to develop ways of experimenting with genes directly, in order to see what they do. **Gene knockout (KO) studies** *involve removing a specific gene and comparing the characteristics of animals with and without that gene*. In one of the first knockout studies of intelligence, researchers discovered that removing one particular gene disrupted the ability of mice to learn spatial layouts (Silva et al., 1992). Since this investigation was completed, numerous studies using gene knockout methods have shown that specific genes are related to performance on tasks that have been adapted to study learning and cognitive abilities in animals (Robinson et al., 2011).

Scientists can also take the opposite approach; instead of knocking genes out, they can insert genetic material into mouse chromosomes to study the changes associated with the new gene. The animal that receives this so-called gene transplant is referred to as a *transgenic* animal. Although this approach may sound like science fiction, it has already yielded important discoveries, such as transgenic mice that are better than average learners (Cao et al., 2007; Tang et al., 1999).

One now-famous example is the creation of "Doogie mice," named after the 1990s TV character Doogie Howser (played by a young Neil Patrick Harris), a genius who became a medical doctor while still a teenager. Doogie mice were created by manipulating a single gene, NR2B (Tang et al., 1999). This gene encodes the NMDA receptor, which plays a crucial role in learning and memory. Having more NMDA receptors should, therefore, allow organisms to retain more information (and possibly to access it more quickly). Consistent with this view, Doogie mice with altered NR2B genes learned significantly faster and had better memories than did other mice. For example, when the Doogie mice and normal mice were put into a tank of water in which they had to find a hidden platform in order to escape, the Doogie mice took half as many trials to remember how to get out of the tank.



The Princeton University lab mouse, Doogie, is able to learn faster than other mice thanks to a bit of genetic engineering. Researchers inserted a gene known as NR2B that helps create new synapses and leads to quicker learning.

Princeton University/KRT/Newscom

The different types of studies reviewed in this section show us that genes do have some effect on intelligence. What they don’t really show us is *how* these effects occur. What causes individual differences in intelligence? One theory suggests that these differences could be due to varying brain size.

Working the Scientific Literacy Model

Brain Size and Intelligence

Listen to the Audio

Are bigger brains more intelligent? We often assume that to be the case—think of the cartoon characters that are super-geniuses; they almost always have gigantic heads. Sure, the real-life Einstein's brain may have been smaller than average, but perhaps that's just an exception to the rule? Many psychologists over the past 150 years have also assumed a correlation between brain size and ability, and have invested great effort and resources to prove it.

What do we know about brain size and intelligence?

Brain-based approaches to measuring intelligence rest on a commonsense assumption: Thinking occurs in the brain, so a larger brain should be related to greater intelligence. But does scientific evidence support this assumption? In the days before modern brain imaging was possible, researchers typically obtained skulls from deceased subjects, filled them with fine-grained matter such as metal pellets, and then transferred the pellets to a flask to measure the volume. These efforts taught us very little about intelligence and brain or skull size, but a lot about problems with measurement and racial prejudice. In some cases, the studies were highly flawed and inevitably led to conclusions that Caucasian males (including the Caucasian male

scientists who conducted these experiments) had the largest brains and, therefore, were the smartest of the human race (Gould, 1981). Modern approaches to studying the brain and intelligence are far more sophisticated, thanks to newer techniques and a more enlightened knowledge of the brain's form and functions.

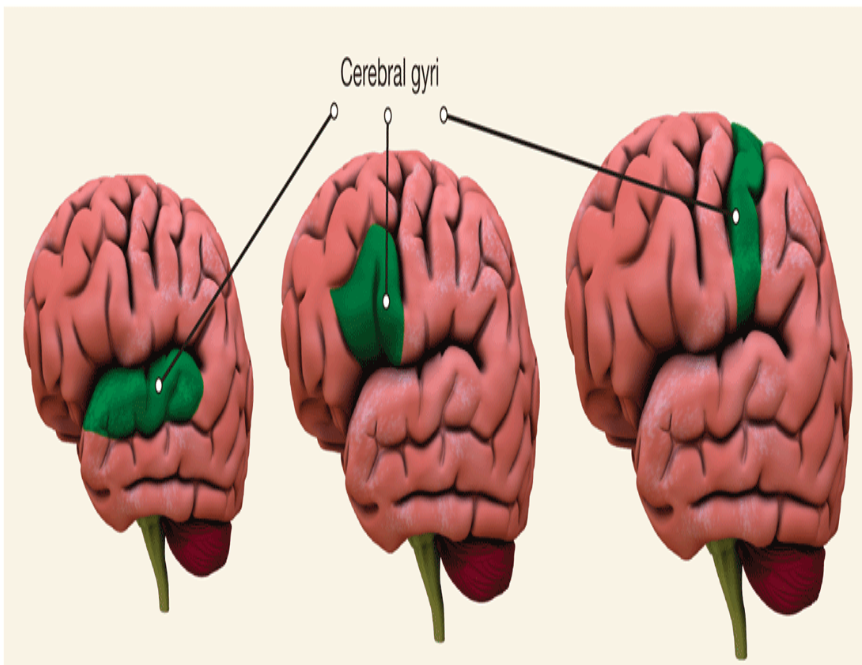
How can science explain the relationship between brain size and intelligence?

In relatively rare cases, researchers have had the two most important pieces of data needed: brains, and people attached to those brains who had taken intelligence tests when they were alive. In one ambitious study at McMaster University, Sandra Witelson and her colleagues (2006) collected 100 brains of deceased individuals who had previously completed the Wechsler Adult Intelligence Scale (WAIS). Detailed anatomical examinations and size measurements were made on the entire brains and certain regions that support cognitive skills. For women and right-handed men (but not left-handed men), 36% of the variation in verbal intelligence scores was accounted for by the size of the brain; however, brain size did not significantly account for the other component of intelligence that was measured: visuospatial abilities. Thus, it appears that brain size does predict intelligence, but certainly doesn't tell the whole story.

In addition to the size of the brain and its various regions, there are other features of our neuroanatomy that might be important to consider. The most obvious, perhaps, is the convoluted surface of fissures and folds (called gyri; pronounced "ji-rye") that comprise the outer part of the cerebral cortex (see Figure 9.12). Interestingly, the number and size of these cerebral gyri seems strongly related to intelligence across different species. Species

that have complex cognitive and social lives, such as elephants, dolphins, and primates, have particularly convoluted cortices (Marino, 2002; Rogers et al., 2010). And indeed, even within humans, careful studies using brain imaging technology have shown that having more convolutions on the surface of certain parts of the cortex was also positively correlated with scores on the WAIS intelligence test, accounting for approximately 25% of the variability in WAIS scores (Luders et al., 2008).

Figure 9.12 Does Intelligence Increase with Brain Size?



While the size of the brain may have a modest relationship to intelligence, the convolutions or “gyri” along the surface of the cortex are another important factor: Increased convolutions are associated with higher intelligence test scores.

Can we critically evaluate this issue?

A common critique of studies examining brain size and IQ is that it is not always clear what processes or abilities are being tested. IQ scores could be measuring a number of things, including

working memory, processing speed, ability to pay attention, or even motivation to perform well on the test. Therefore, when studies show that brain size can account for 25% of the variability in IQ scores, it is not always clear what ability (or abilities) are underlying these results.

Another potential problem is the *third-variable problem*. Even if brain size and performance on intelligence tests are correlated with each other, it might be the case that they are both related to some other factor, like stress, nutrition, physical health, environmental toxins, or the amount of enriching stimulation experienced during childhood (Choi et al., 2008). If these other factors can account for the relationship between brain size and intelligence, then the brain–IQ relationship itself may be overestimated.

A final critique is simply the recognition that there is more to intelligence than just the size of your brain. After all, if brain size explains 25% of the variability in IQ scores, the other 75% must be due to other things.

Why is this relevant?

It's not likely that we will soon be measuring brain size for things such as university admissions—we have other tests for that. However, this research is important for reasons that go far beyond the issue of intelligence and aptitude tests. As the examination of Einstein's brain illustrates, the overall size of the brain may be less important than the size and structure of specific regions. Research focusing on the relationship between specific brain structures and functions is proving very important indeed. For example, certain harmful patterns of behaviour, such as anorexia nervosa (a psychological disorder marked by self-starvation) or prolonged periods of alcohol abuse, have both

been shown to lead to changes in cognitive abilities and corresponding loss of brain volume (e.g., McCormick et al., 2008; Schottenbauer et al., 2007). Measurements of brain volume have also played a key role in understanding the impaired neurological and cognitive development of children growing up in institutional settings (e.g., orphanages), as well as how these children benefit from adoption, foster care, or increased social contact (Sheridan et al., 2012). Better understanding of how experiences like anorexia, alcoholism, and child neglect affect brain development may provide ways of developing effective interventions that could help people who have suffered from such experiences.

Environmental Influences on Intelligence

Listen to the Audio

As described earlier, research on the *biological* underpinnings of intelligence repeatedly emphasizes the importance of *environmental* factors. For example, environmental conditions determine which genes get expressed ("turned on") for a given individual. Thus, without the right circumstances, genes can't appropriately affect the person's development. Also, brain areas involved in intelligence are responsive to a wide variety of environmental factors. The full story of how "nature" influences intelligence is intricately bound up with the story of how "nurture" influences intelligence.

Both animal and human studies have demonstrated how environmental factors influence cognitive abilities. Controlled experiments with animals show that growing up in physically and socially stimulating environments results in faster learning and enhanced brain development compared to growing up in a dull environment (Hebb, 1947; Tashiro et al., 2007). For example, classic studies in the 1960s showed that rats who grew up in enriched environments (i.e., these rats enjoyed toys, ladders, and tunnels) ended up with bigger brains than rats who grew up in impoverished environments (i.e., simple wire cages). Not only were their cerebral cortices approximately 5% larger (Diamond et al., 1964; Rosenzweig et al., 1962), but their cortices contained 25% more synapses (Diamond et al., 1964). With more synapses, the brain can make more associations, potentially enhancing cognitive abilities such as learning

and creativity. In this section, we review some of the major environmental factors that influence intelligence.

Birth Order

Listen to the Audio

One of the most difficult environmental factors to research is birth order. Does intelligence depend to some degree on whether you were the oldest child in your family, or whether you were lower in the pecking order of your siblings? Debate about this issue has continued for many decades within psychology (and even more fiercely among many siblings). The evidence seems to indicate that birth order does matter. For example, a 2007 study of more than 240 000 people in Norway found that the IQs of first-born children are, on average, about three points higher than those of second-born children and four points higher than those of third-born children (Kristensen & Bjerkedal, 2007).

Why birth order matters is far more debatable. It could be that the first born gets the most one-to-one interaction with parents during the first years of life, and perhaps also the most highly motivated parents. Meanwhile, the third and fourth children are part of a crowd, and the exhausted parents cannot possibly provide the same amount of high quality attention to the later-born kids (Price, 2008; Lehmann et al., 2018). This is not just a disadvantage for the younger sibling. Older siblings, like it or not, end up tutoring and mentoring younger siblings, imparting the wisdom they have gained through experiences. Although this may help the younger sibling, the act of teaching their knowledge benefits the older sibling more (Zajonc, 1976). The act of teaching requires the older sibling to rehearse previously remembered information and to reorganize it in a way that their younger sibling will understand.

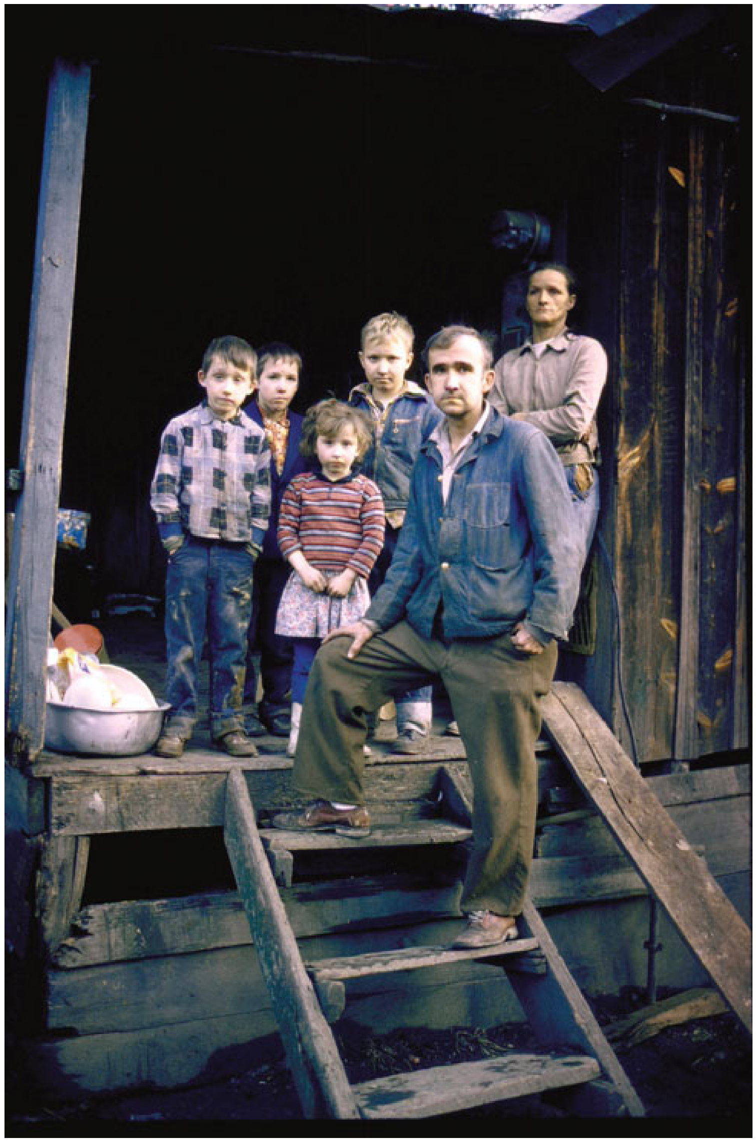
Teaching therefore leads to a deeper processing of the information, which, in turn, increases the likelihood that it will be remembered later (see Module 7.2).

Before any first-born children reading this section start building monuments to their greatness, it is important to note that the differences between the IQs of first- and later-born siblings are quite small: three or four points. There will definitely be many individual families in which the later-born kids have higher IQs than their first-born siblings. Nevertheless, this finding is one example of how environments can influence intelligence.

Socioeconomic Status

Listen to the Audio

One of the most robust findings in the intelligence literature is that IQ correlates strongly with socioeconomic status (SES). It is perhaps no surprise that children growing up in wealthy homes have, on average, higher IQs than those growing up in poverty (Turkheimer et al., 2003), but there may be many reasons for this that have nothing to do with the "innate" or potential intelligence of the rich or the poor. Think of the many environmental differences and greater access to resources and opportunities enjoyed by the wealthy! For example, consider how much language children are exposed to at home. One U.S. study estimated that by age three, children of professional parents will have heard 30 million words, children of working-class parents will have heard only 20 million words, and children of unemployed African-American mothers will have heard only 10 million words. Furthermore, the *level* of vocabulary is strikingly different for families in the different socioeconomic categories, with professional families using the most sophisticated language (Hart & Risley, 1995).



Socioeconomic status is related to intelligence. People from low-socioeconomic backgrounds typically have far fewer opportunities to access educational and other important resources that contribute to intellectual growth.

John Dominis/Getty Images

Other studies have shown that higher SES homes are much more enriching and supportive of children's intellectual development—high SES parents talk to their children more; have more books, magazines, and newspapers in the home; give them more access to computers; take them

to more learning experiences outside the home (e.g., visits to museums); and are less punitive toward their children (Bradley et al., 1993; Phillips et al., 1998).

Unfortunately, the effects of SES don't end here. SES interacts with a number of other factors that can influence intelligence, including nutrition, stress, and education. The difference between rich and poor people's exposure to these factors almost certainly affects the IQ gap between the two groups.

Nutrition

Listen to the Audio

It's a cliché we are all familiar with—"you are what you eat." Yet over the past century, the quality of the North American diet has plummeted as we have adopted foods that are highly processed, high in sugar and fat, low in fibre and nutrients, and laden with chemicals (preservatives, colours, and flavourings). Some evidence suggests that poor nutrition could have negative effects on intelligence. For example, research has shown that diets high in saturated fat quickly lead to sharp declines in cognitive functioning in both animal and human subjects. In contrast, diets low in such fats and high in fruits, vegetables, fish, and whole grains are associated with higher cognitive functioning (Greenwood & Winocur, 2005; Parrott & Greenwood, 2007).

A massive longitudinal study on diet is currently underway in the United Kingdom. The Avon Longitudinal Study of Parents and Children is following the development of children born to 14 000 women in the early 1990s. This research has shown that a "poor" diet (high in fat, sugar, and processed foods) early in life leads to reliably lower IQ scores by age eight-and-a-half, whereas a "health-conscious" diet (emphasizing salads, rice, pastas, fish, and fruit) leads to higher IQs. Importantly, this was true even when researchers accounted for the effects of other variables, such as socioeconomic status (Northstone et al., 2012).

So what kinds of foods should we eat to maximize our brainpower? Although research on nutrition and intelligence is still relatively new, it

would appear that eating foods low in saturated fats and rich in omega-3 fats, whole grains, and fruits and veggies are your smartest bets.

Stress

Listen to the Audio

High levels of stress in economically poor populations is also a major factor in explaining the rich–poor IQ gap. People living in poverty are exposed to high levels of stress through many converging factors, ranging from higher levels of environmental noise and toxins, to more family conflict and community violence, to less economic security and fewer employment opportunities. These and many other stresses increase the amounts of stress hormones such as cortisol in their bodies, which in turn is related to poorer cognitive functioning (Evans & Schamberg, 2009). High levels of stress also interfere with working memory (the ability to hold multiple pieces of information in memory at one time; Evans & Schamberg, 2009), and the ability to persevere when faced with challenging tasks, such as difficult questions on an IQ test (Evans & Stecker, 2004). These deficits interfere with learning in school (Blair & Razza, 2007; Ferrer & McArdle, 2004).

The toxic effects of chronic stress show up in the brain as well, damaging the neural circuitry of the prefrontal cortex and hippocampus, which are critical for working memory and other cognitive abilities (e.g., controlling attention, cognitive flexibility) as well as for the consolidation and storage of long-term memories (McEwen, 2000). In short, too much stress makes us not only less healthy, but can make us less intelligent as well.

Education

Listen to the Audio

One of the great hopes of modern society has been that universal education would level the playing field, allowing all children, rich and poor alike, access to the resources necessary to achieve success. Certainly, attending school has been shown to have a large impact on IQ scores (Ceci, 1991). During school, children accumulate factual knowledge, learn basic language and math skills, and learn skills related to scientific reasoning and problem solving. Children's IQ scores are significantly lower if they do not attend school (Ceci & Williams, 1997; Nisbett, 2009). In fact, for most children, IQ drops even over the months of summer holiday (Ceci, 1991; Jencks et al., 1972), although the wealthiest 20% actually show gains in IQ over the summer, presumably because they enjoy activities that are even more enriching than the kinds of experiences delivered in the classroom (Burkam et al., 2004; Cooper et al., 2000). However, although education has the potential to help erase the rich–poor gap in IQ, its effectiveness at doing so will depend on whether the rich and poor have equal access to the same quality of education and other support and resources that would allow them to make full use of educational opportunities.

Clearly, environmental factors such as nutrition, stress, and education all influence intelligence, which gives us some clues as to how society can contribute to improving the intelligence of the population. Interestingly, exactly such a trend has been widely observed across the past half-

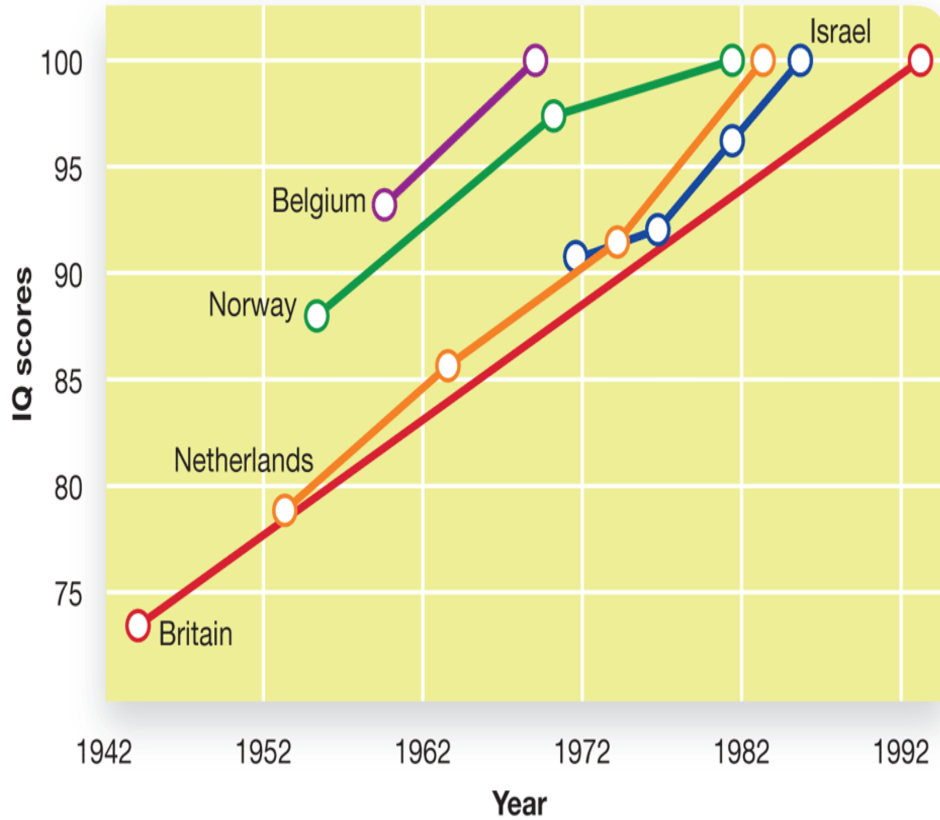
century or so; it appears that generation after generation, people are getting smarter!

The Flynn Effect: Large-Scale Trends in Average IQ

Listen to the Audio

The **Flynn effect**, named after researcher James Flynn, *refers to the steady population level increases in intelligence test scores over time* (Figure 9.13). This effect has been found in numerous situations across a number of countries in samples from the mid to late 20th century. For example, in the Dutch and French militaries, IQ scores of new recruits rose dramatically between the 1950s and 1980s—21 points for the Dutch and about 30 for the French (Flynn, 1987). From 1932 to 2007, Flynn estimates that, in general, IQ scores rose about one point every three years (Flynn, 2007).

Figure 9.13 The Flynn Effect



Throughout the 20th century, there had been a general trend toward increasing IQ scores. This trend, called the Flynn effect, seems to have slowed, or maybe even reversed in the 2000s.

Source: Flynn, J. R. (1999). Searching for justice: The discovery of IQ gains over time. *American Psychologist*, *54*, 5–20.

The magnitude of the Flynn effect is striking. Imagine if the trends in the Dutch sample described above continued: today's group of 18-year-olds would score 35 points higher than 18-year-olds in 1950. The average person back then had an IQ of 100, but the average person today, taking the same test, would score 135, which is above the cut-off considered "gifted" in most gifted education programs! Or consider this the opposite way—if the average person today scored 100 on today's test, the average person in 1950 would score about 65, enough to qualify as mentally disabled.

If the Flynn effect meant that everyone was getting smarter, some now wonder whether we might have a problem on our hands: the *negative Flynn effect*. This is the observation that the trend of increasing IQ scores has stalled, and it looks like it has even reversed in some places (Dutton et al., 2016). We doubt there is any cause for alarm, however, because the generations at the beginning of the Flynn effect were quite intelligent, achieving remarkable things in science, arts, and other intellectually challenging areas. Instead, the negative Flynn effect provides an opportunity to more closely examine the causes for widespread, long-term trends in IQ gains and declines. For example, researchers have built strong evidence against the dysgenic hypothesis—the apparently mistaken assertion that IQs are going down because low-IQ parents are having more children than high-IQ parents, or that immigration from low-IQ populations is somehow "diluting" high- IQ populations. Although it appeals to some political orientations, neither version of the dysgenic hypothesis has any scientific support. The negative Flynn effect has opened techniques such as comparing changes in IQ within generations of a family versus between families, as well as within and between various geographical regions. This recent research found new evidence that is consistent with genetic factors, as well as environmental influences (Bratsburg & Rogeburg, 2018; Dutton et al., 2016)

So how can environmental factors affect the IQ scores of an entire generation? One of the most likely explanations for the Flynn effect is that modern society requires certain types of intellectual skills, such as abstract thinking, scientific reasoning, classification, and logical analysis. Throughout the 20th century, each successive generation spent more time manipulating information with their minds, more time with visual media, and more time in school. It seems reasonable to propose that these shifts in information processing led to the increases in IQ scores (Nisbett et al., 2012). The end of the Flynn effect could be explained by claiming the population has reached its peak IQ within the technological environment.

However, such conclusions are challenged by the negative Flynn effect. Because psychologists have been able to rule out genetic factors, they must now ask, what has changed?

Behavioural Influences on Intelligence

Listen to the Audio

If you want to make yourself more intelligent, we've covered a number of ways to do that—eat a brain-healthy diet, learn how to manage stress better, keep yourself educated (if not in formal schooling, then perhaps by continuing to be an active learner), and expose yourself to diverse and stimulating activities. But is there anything else you can do? For example, if you want bigger muscles, you can go to the gym and exercise. Can you do the same thing for the brain?

#Psych

Can a Workout Strengthen Your Brain?

Over the past decade, a number of "brain training" apps have appeared on the market claiming to improve working memory and other cognitive skills. The idea behind such programs is that playing games related to memory and attention will not only improve your performance on these games, but will also help you use those abilities in other, real-world situations. This definitely works for athletes who target muscles groups with weights, stretches, and repetitive motions. But the brain is not a muscle, so does the analogy hold up?

Early tests seemed to support brain-training apps. For instance, participants practising an "N-back" task seemed to

improve working memory. In this task, people are presented with a stimulus, such as squares that light up on a grid, and are asked to press a key if the position on the grid is the same as the last trial. The task gets progressively more difficult, requiring participants to remember what happened two, three, or more trials ago (although it takes considerable practice for most people to be able to reliably remember what happened even three trials ago). Practising the N-back task was shown to not only improve performance at that task, but also to increase participants' fluid intelligence (Jaeggi et al., 2008).

However, recent reviews of this area of research show that the effects are quite limited (Foroughi et al., 2016; Simons et al., 2016). Practising games related to working memory will improve performance on those games, but will rarely have an effect on other types of tasks, particularly on behaviours occurring outside of the laboratory (Melby-Lervåg & Hulme, 2013). Although these results are disappointing for those who want to increase their IQ scores, they help remind us of the importance of being critical consumers of scientific information.

Nootropic Drugs

Listen to the Audio

Another behaviour that many people believe improves their cognitive functioning is the use of certain drugs. **Nootropic substances** (meaning "affecting the mind") *are substances that are believed to beneficially affect intelligence*. Nootropics can work through many different mechanisms, from increasing overall arousal and alertness, to changing the availability of certain neurotransmitters, to stimulating nerve growth in the brain.

Certainly, these drugs work in some situations. For example, methylphenidate (Ritalin) and modafinil (Provigil) are prescribed to help people with attentional disorders. They may also boost specific functions in the general population (Elliott et al., 1997; Turner et al., 2003); however, these drugs not come without risk. We do not yet know what might be the long-term consequences of these drugs, and there is also the possibility for abuse and dependency (Sahakian & Morein-Zamir, 2007). Because of these risks, a September 2013 review in the *Canadian Medical Association Journal* recommended that doctors "should seriously consider refusing to prescribe medications for cognitive enhancement to healthy individuals" (Forlini et al., 2013, p. 1047).

These risks have to be weighed against the potential benefits of developing these drugs, at least for clinical populations. For example, researchers in the United Kingdom have argued that if nootropic drugs could improve the cognitive functioning of Alzheimer's patients by even a small amount, such as a mere 1% change in the severity of the disease

each year, this would be enough not only to dramatically improve the lives of people with Alzheimer's and their families, but to completely erase the predicted increases in long-term health care costs for the U.K.'s aging population (Sahakian & Morein-Zamir, 2007).

In sum, although few people are blessed with brains as abnormally intelligent as Einstein's, there are practical things anyone can do to maximize their potential brainpower that are safer than the misuse of prescription drugs. From eating better to providing our brains with an enriching environment, we can use the science of intelligence to make the most out of our genetic inheritance.

Module 9.3 Summary

Listen to the Audio

9.3a Know . . . the key terminology related to heredity, environment, and intelligence.

Review Module 9.3

Start Over Swap

0/3 REVIEWED · 0 MASTERED

nootropic substances

Previous Next Got It!

9.3b Understand . . . different approaches to studying the genetic basis of intelligence.

Behavioural genetics typically involves conducting twin or adoption studies. Behavioural genomics involves looking at gene–behaviour

relationships at the molecular level. This approach often involves using animal models, including knockout and transgenic models.

9.3c Apply . . . your knowledge of environmental and behavioural effects on intelligence to understand how to enhance your own cognitive abilities.

Apply Activity

Based on the research we reviewed, there are many different strategies that are good bets for enhancing the cognitive abilities that underlie your own intelligence. Try to distinguish the sound, evidence-based suggestions from the bad.

To improve cognitive function in a safe, healthy way, evidence suggests...

Previous Next

9.3d Analyze . . . the belief that older children are more intelligent than their younger siblings.

Reviews of intelligence tests show that the oldest child in a family tends to have a higher IQ than their younger siblings. However, this effect is quite small: three IQ points. Importantly, this difference is not due to the genetic superiority of the older siblings. Rather, it is likely related to the fact that older children often spend time teaching things to their younger siblings.

Chapter 10
Lifespan Development

Listen to the Audio

10.1 Physical Development from Conception through Infancy

- Methods for Measuring Developmental Trends
- Zygotes to Infants: From One Cell to Billions
- Working the Scientific Literacy Model: The Long-Term Effects of Premature Birth
- Sensory and Motor Development in Infancy
- Module 10.1 Summary

10.2 Infancy and Childhood: Cognitive and Emotional Development

- Cognitive Changes: Piaget's Cognitive Development Theory
- Working the Scientific Literacy Model: Evaluating Piaget
- Social Development, Attachment, and Self-Awareness
- Psychosocial Development
- Module 10.2 Summary

10.3 Adolescence

- Physical and Emotional Changes in Adolescence
- Emotional Challenges in Adolescence

Working the Scientific Literacy Model: Adolescent Risk and Decision Making

Cognitive Development: Moral Reasoning vs. Emotions

Social Development: Identity and Relationships

Module 10.3 Summary

10.4 Adulthood and Aging

From Adolescence through Middle Age

Late Adulthood

Working the Scientific Literacy Model: Aging and Cognitive Change

Module 10.4 Summary

Module 10.1 Physical Development from Conception through Infancy

Listen to the Audio

Leungchopan/Fotolia

Learning Objectives

10.1a Know . . . the key terminology related to prenatal and infant physical development.

10.1b Understand . . . the pros and cons of different research designs in developmental psychology.

10.1c Apply . . . your understanding to identify the best ways expectant parents can ensure the health of their developing fetus.

10.1d Analyze . . . the effects of preterm birth.

It is difficult to overstate the sheer miracle and profundity of birth. Consider the following story, told by a new father. "About two days after the birth of my first child, I was driving to the hospital and had one of 'those moments,' an awe moment, when reality seems clear and wondrous. What triggered it was that the person driving down the highway in the car next to mine yawned. Suddenly, I remembered my newborn baby yawning just the day before, and somehow, it hit me—we are all just giant babies, all of us, the power broker in the business suit, the teenager in jeans and a hoodie, the tired soccer parent in the mini-van, and the elderly couple holding hands on the sidewalk. Although we have invented these complex inner worlds for ourselves, with all of our cherished opinions, political beliefs, dreams, and aspirations, at our essence, we are giant babies. We have the same basic needs as babies—food, security, love, air, water. Our bodies are basically the same, only bigger. Our brains are basically the same, only substantially more developed. Our movements are even basically the same, just more coordinated. I like to remember that now and then, when I feel intimidated by someone, or when I feel too self-important. Just giant babies!"

Of course, we don't stay "just babies" over our lives. We develop in many complex ways as we age and learn to function in the world. Understanding how we change, and how we stay the same, over the course of our lives, is what developmental psychology is all about.

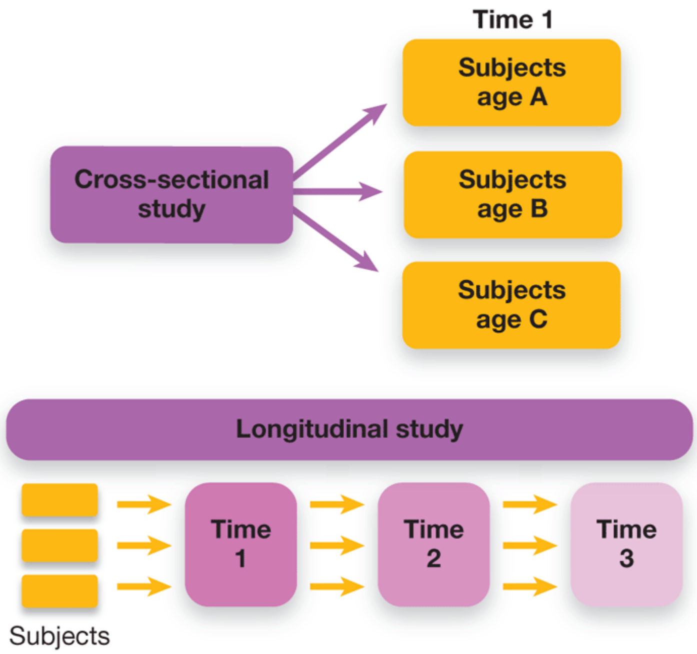
Developmental psychology *is the study of human physical, cognitive, social, and behavioural characteristics across the lifespan*. Take just about anything you have encountered so far in this text, and you will probably find psychologists approaching it from a developmental perspective. From neuroscientists to cultural psychologists, examining how we function and change across different stages of life raises many central and fascinating questions.

Methods for Measuring Developmental Trends

Listen to the Audio

Studying development requires some special methods for measuring and tracking change over time. A **cross-sectional design** *is used to measure and compare samples of people at different ages at a given point in time*. For example, to study cognition from infancy to adulthood, you could compare people of different age groups—say, groups of 1-, 5-, 10-, and 20-year-olds. In contrast, a **longitudinal design** *follows the development of the same set of individuals through time*. With this type of study, you would select a sample of infants and measure their cognitive development periodically over the course of 20 years (see Figure 10.1).

Figure 10.1 Cross-Sectional and Longitudinal Methods



In cross-sectional studies, different groups of people—typically of different ages—are compared at a single point in time. In longitudinal studies, the same group of subjects is tracked over multiple points in time.

These different methods have different strengths and weaknesses. Cross-sectional designs may be more cost effective than longitudinal ones, and they allow a study to be done quickly (because you don't have to wait around while your participants age). On the other hand, they can suffer from **cohort effects**, which are *differences between people that result from being born in different time periods*. For example, if you find differences between people born in the 2000s with those born in the 1970s, this may reflect any number of differences between people from those time periods—such as differences in technological advances, parenting norms, cultural changes, environmental pollutants, nutritional practices, or many other factors. This creates big problems in interpreting the findings of a study—do differences between the age groups reflect normal developmental processes or do they reflect more general differences between people born into these time periods?

A longitudinal study fixes the problem of cohort effects, but these studies are often difficult to carry out and tend to be costly and time consuming to follow, due to the logistic challenges involved in following a group of people for a long period of time. Longitudinal designs often suffer from the problem of *attrition*, which occurs when participants drop out of a study for various reasons, such as losing interest or moving away.

The combination and accumulation of cross-sectional and longitudinal studies have taught us a great deal about the processes of human development. This can help parents and educators who want to have a positive influence on children's development. It can help us understand how to better serve the needs of those who are aging. And it can help all of us, who just want to better understand who we are, and why we turned out the way that we did.

Patterns of Development: Stages and Continuity

Listen to the Audio

One of the most fascinating aspects of psychology is that human development does not unfold in a gradual, smooth, linear fashion; instead, periods of seeming stability are interrupted by sudden, often dramatic growth and change. Whether we study physical, cognitive, emotional, or social development, we find remarkable transitions from one pattern of functioning to a qualitatively different one. You might remember one of these dramatic periods of change from your early adolescence. You most likely did more than just grow a couple of years older. You probably emerged with a fundamentally different body, ways of relating to parents and friends, and an ability to think more deeply about complex, abstract problems. What you probably don't remember is going through other dramatic shifts in physical and psychological functioning several times before you hit puberty. These periods of rapid change are described by several *stage models* of human development. These models emphasize the difference between stages—periods of gradual growth spent fine-tuning new skills—and the periods of rapid change between them.

Zygotes to Infants: From One Cell to Billions

Listen to the Audio

The earliest stage of development begins at the moment of conception, when a single sperm (out of approximately 200 million that start the journey into the vagina) is able to find its way into the ovum (egg cell). At this moment, the ovum releases a chemical that bars any other sperm from entering, and *the nuclei of egg and sperm fuse, forming the* **zygote**. Out of the mysterious formation of this single cell, the rest of our lives flow.

Fertilization and Gestation

Listen to the Audio

The formation of the zygote through the fertilization of the ovum marks the beginning of the **germinal stage**, *the first phase of prenatal development, which spans from conception to two weeks*. Shortly after it forms, the zygote begins dividing, first into two cells, then four, then eight, and so on. The zygote also travels down the fallopian tubes toward the uterus, where it becomes implanted into the lining of the uterus (Table 10.1). The ball of cells, now called a blastocyst, splits into two groups. The inner group of cells develops into the fetus. The outer group of cells forms the placenta, which will pass oxygen, nutrients, and waste to and from the fetus.

Table 10.1 Phases of Prenatal Development

Click through the simulation to reveal the major events at each phase of prenatal development.

1 of 4 Previous Next

Source: Dough Steley A/Alamy Stock Photo; MedicalRF.com/Alamy Stock Photo; Claude Edelmann/Photo Researchers, Inc./Science Source

Although the terms *embryo* and *fetus* are very well known, surprisingly few adults remember what distinguishes the two. Treating these as development stages can highlight the differences. For starters, the **embryonic stage** *spans weeks two through eight, during which time the embryo begins developing major physical structures such as the heart and nervous system, as well as the beginnings of arms, legs, hands, and feet*. Essentially, this is the stage in which the physical systems that define our species emerge from a cluster of cells. Following this, the **fetal stage** *spans week eight through birth, during which time the skeletal, organ, and nervous systems become more developed and specialized*. Muscles develop and the fetus begins to move. Sleeping and waking cycles start and the senses become fine-tuned—even to the point where the fetus is responsive to external cues (these events are summarized in Table 10.1). So once the body emerges in the embryonic stage, the fetal stage allow those structures to grow and begin to function.

Fetal Brain Development

Listen to the Audio

The beginnings of the human brain can be seen during the embryonic stage when nerve cells first develop. Within two weeks of conception, a layer of these specialized cells begins to fold over onto itself, forming a distinct tube-shaped structure. This *neural tube* eventually develops into the brain and spinal cord (Lenroot & Gledd, 2007; O'Rahilly & Mueller, 2008). The first signs of the major divisions of the brain—the forebrain, the midbrain, and the hindbrain—are apparent at only four weeks (see Figure 10.2). Around seven weeks, the spinal cord has developed enough for the fetus's limbs to move, which ushers in a stage of strengthening and coordination (Kurjak et al., 2005). By 11 weeks, structures recognized in adult brains have developed, including the cerebral hemispheres, cerebellum, and brain stem. By the end of the second trimester, the outer surface of the cerebral cortex has formed the initial folds and ridges that give the adult brain its familiar appearance. (Pregnancy is divided into three, 3-month periods called trimesters.) It is around the same time that myelin begins to build up around developing nerve cells, enabling them to conduct messages more rapidly and efficiently (see Module 3.2; Giedd, 2008).

Figure 10.2 Fetal Brain Development

The origins of the major regions of the brain are already detectable at four weeks' gestation. Their differentiation progresses rapidly, with the major forebrain, midbrain, and hindbrain regions becoming increasingly specialized. Select "Next" to advance to the next slide to see how prenatal brain development progresses.

1 of 6 Previous Next

At birth, the newborn has an estimated 100 billion neurons and a brain that is approximately 25% the size and weight of an adult brain. Astonishingly, this means that by the time of birth, the infant has been developing up to 4000 new neurons per *second* in the womb (Brown et al., 2001). However, most of the connections between these neurons have not yet been established in the brain of a newborn (Kolb, 1989, 1995). Although the basic shape and structure of our brains is guided by the human genome (see Module 3.1), the strength of the connections between individual brain cells and the pathways between brain regions depends on experience.

Nutrition, Teratogens, and Fetal Development

Listen to the Audio

The rapidly developing fetal brain is highly vulnerable to environmental influences. For example, proper nutrition is the single most important non-genetic factor affecting fetal development in typical environments (assuming minimal exposure to toxic substances; Phillips, 2006). The nutritional demands of a developing infant are such that women typically require an almost 20% increase in energy intake during pregnancy, including sufficient quantities of protein (which affects neurological development; Morgane et al., 2002) and other nutrients (e.g. omega-3 fatty acids, folic acid, and calcium). In the fetal stage, malnutrition can have severe consequences. (Children who were malnourished in the womb are more likely to experience attention deficit disorders and difficulties controlling their emotions, due to underdeveloped prefrontal cortices and other brain areas involved in self-control (Morgane et al., 2002; Vohr et al., 2017).).

Fetal development can also be disrupted through exposure to **teratogens**, *substances, such as drugs or environmental toxins, that impair the process of development*. One of the most infamous and heartbreaking examples of teratogens is thalidomide, a sedative that was hailed as a wonder drug for morning sickness during pregnancy. Available in Canada from 1959 to 1962, thalidomide had serious, undesirable effects, causing miscarriages and nervous system birth defects such as blindness and deafness. Its most well-known effect, *phocomelia*, results from impaired

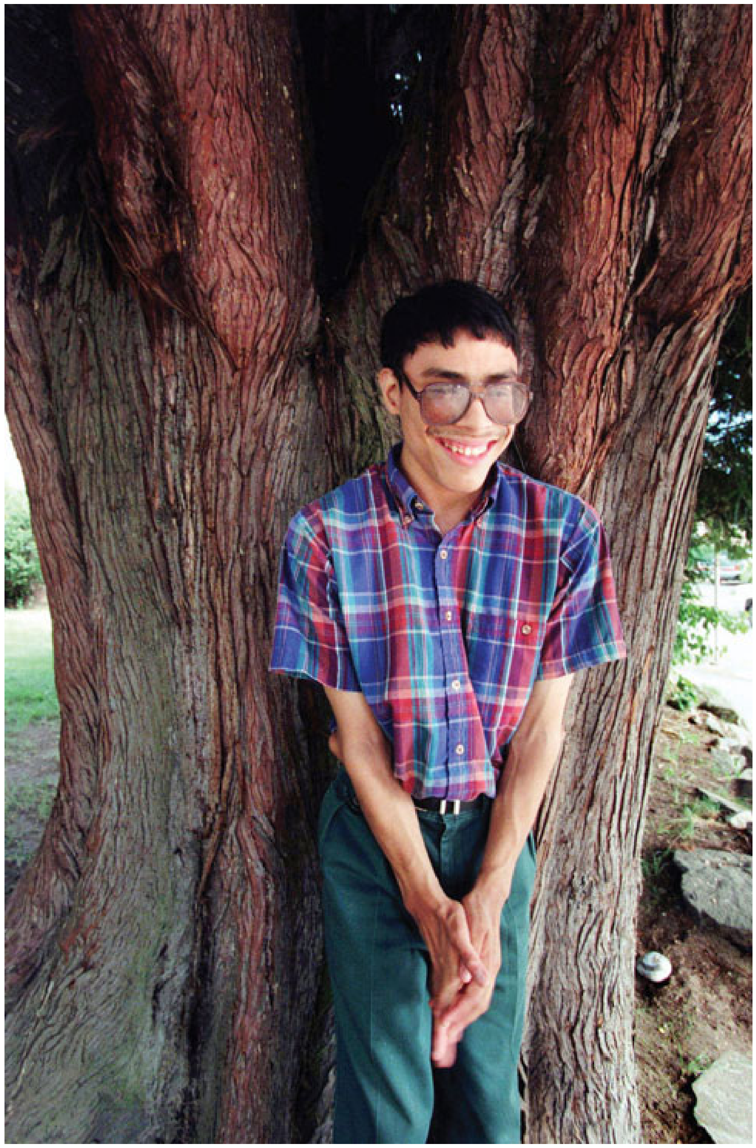
physical development;: the hands, feet, or both emerged directly from their shoulders or hips.

Victims of thalidomide: This sedative seemed like a miracle drug in the late 1950s, until its tragic effects on fetal development became apparent.

Dpa picture alliance/Alamy Stock Photo

Thalidomide is no longer a threat, but more common teratogens remain, especially alcohol and tobacco. First described in the 1970s (Jones & Smith, 1973), **fetal alcohol spectrum disorders** consist of *abnormalities in mental functioning, growth, and physical development in the offspring of women who use alcohol during pregnancy*. This condition occurs in approximately 1.5 per 1000 births worldwide, but the specific rates likely vary greatly in different regions (Popova et al., 2017). It is likely that FAS has been underreported (or has been misdiagnosed as something else), and thus the effects of fetal alcohol exposure may be more widespread than is currently recognized (Morleo et al., 2011).

About one in 10 pregnancies in Canada involve ingesting alcohol (Walker et al., 2011), and in some communities, such as those in isolated Northern regions, more than 60% of pregnancies have been shown to be alcohol-exposed (Muckle et al., 2011). This statistic is particularly worrisome when research suggests there is no safe limit for alcohol consumption by a pregnant woman; even one drink per day may be enough to impair fetal development (O'Leary et al., 2010; Streissguth & Connor, 2001). The effects of alcohol on the developing fetus may also be affected by the father's drinking. A study using mice as a model suggests that paternal alcohol use affects sperm, which in term has a negative impact on the growth and development of mouse pups (Lee et al., 2013). Further research is needed to confirm that the same effect happens in humans.



Fetal alcohol syndrome is diagnosed based on facial abnormalities, growth problems, and behavioural and cognitive deficits.

Betty Udesen/KRT/Newscom

Smoking also exposes the developing fetus to teratogens. Babies born to mothers who smoke are twice as likely to have low birth weight and have a 30% chance of premature birth—both factors that increase the newborn's risk of illness or death. Evidence also suggests an increased risk for problems with emotional development and impulse control (Brion

et al., 2010; Wiebe et al., 2014), as well as attentional and other behavioural problems (Marroun et al., 2014; Sen & Swaminathan, 2007).

Finally, maternal stress activates genetic processes that can in turn interfere with normal prenatal development (Cao-Lei et al., 2018). Every expecting mother experiences some level of stress during pregnancy, and these stressors can come from all aspects of life: relationships, finances, community, and especially the psychological adjustment to having another human being so dependent on her. As you can imagine, differences in geographic location and financial resources correlate to important factors such as better prenatal healthcare, nutrition, and stable social environments. This is the case even in countries with strong national health care systems (Guliani et al., 2013; Kim et al., 2018). Regardless of socioeconomic factors, strong social support and effective psychological coping skills are associated with positive fetal developmental (Goeletzke et al., 2017).

Myths in Mind

The Myth of Vaccinations and Autism

When you consider all the ways people try to promote healthy infant development, it is surprising that some parents actively avoid one of the most scientifically established, effective, and safest tools—vaccination. A major controversy erupted in the late 1990s about a widely administered vaccine designed to prevent measles, mumps, and rubella (MMR). A publication from one British lab linked the MMR vaccine to the development of autism, but the science was later discredited. This was such clear and blatant violation of research and medical ethics that the journal retracted the article, and the

key researcher (Andrew Wakefield) lost his licence to practise medicine. Nonetheless, he continued to promote his views against vaccines through public-speaking appearances and rallies, and the anti-vaccine movement remained convinced that vaccines were scarier than the diseases they prevented.

The net result has been a public health tragedy. For example, in Canada, measles was considered to have been eliminated as an endemic disease by 1997 and in the United States shortly thereafter; any further cases would have to have been imported from other areas of the world. The approximately 100 new cases each year came across international borders, and were easily dealt with because of near universal immunity in the population. However, as the anti-vaccine movement continued to spread conspiracies entirely at odds with decades of data from laboratories, clinical practice, and public health, these gains began to reverse. By 2011, more than 30 European countries, plus Canada and the United States, saw huge spikes in measles cases, with particularly worrying outbreaks occurring in France, Québec, and numerous regions of the United States (CDC, 2019; Sherrard et al., 2015).

The take-home message? There is no evidence that vaccines cause autism. On the contrary, all the evidence suggests that vaccines prevent far more problems than they might cause.

Working the Scientific Literacy Model

The Long-Term Effects of Premature Birth

Listen to the Audio

The human mother's womb has evolved to be a close-to-ideal environment for a fetus's delicate brain and body to prepare for life outside the womb. Premature birth thrusts the vulnerable baby into a much less congenial environment before they are ready; how does this affect development?

What do we know about premature birth?

Typically, humans are born at a gestational age of around 40 weeks. **Preterm infants** *are born earlier than 36 weeks*. Preterm babies often have underdeveloped brains and lungs, which present a host of immediate challenges, such as breathing on their own and maintaining an appropriate body temperature. With modern medical care, babies born at 30 weeks have a very good chance of surviving (approximately 95%), although for those born at 25 weeks, survival rates drop to only slightly above 50% (Dani et al., 2009; Jones et al., 2005). Although babies born at less than 25 weeks often survive, they run a very high risk of damage to the brain and other major organs. To try to reduce these risks and improve outcomes as much as possible, medical science is continually seeking better procedures for nurturing preterm infants.

How can science be used to help preterm infants?

Researchers have compared different methods for improving survival and normal development in preterm infants. One program, called the Newborn Individualized Developmental Care and Assessment Program (NIDCAP), is a behaviourally based intervention in which preterm infants are closely observed and given intensive care during early development. To keep the delicate brain protected against potentially harmful experiences, NIDCAP calls for minimal lights, sound levels, and stress.

Controlled studies suggest that this program works (Moody et al., 2017). Researchers randomly assigned 117 infants born at 29 weeks or less gestational age to receive either NIDCAP or standard care in a prenatal intensive care unit. Within nine months of birth, the infants who received the NIDCAP care showed significantly improved motor skills, attention, and other behavioural skills, as well as superior brain development (McAnulty et al., 2009). A longitudinal study indicates that these initial gains last for a long time. Even at eight years of age, those who were born preterm and given NIDCAP treatment scored higher on measures of reasoning and problem solving than children who were born preterm but did not have NIDCAP treatment (McAnulty et al., 2010). Researchers have also found that skin-to-skin contact affects both the infant and the parent, most likely by altering endocrine system activity (Vittner et al., 2018).

Can we critically evaluate this research?

The chief limitation of Moody et al.'s longitudinal study is its small sample size (only 22 children across the two conditions) so we must question its generalizability. Without a large, diverse sample, we don't know whether the effectiveness of the program

depends on the child's gender, family socioeconomic status, or ethnicity. This study also does not identify *why* the program works—which specific mechanisms it affects in turn improve development. These questions don't nullify previous findings; instead they have become promising directions for future research.

Why is this relevant?

Worldwide, an estimated 9% of infants are born preterm (Villar et al., 2003). Medical advances have increased the likelihood of survival of these children, and behaviourally based interventions such as NIDCAP have improved physical and psychological development. For example, massaging preterm infants for a mere 15 minutes per day can result in a 50% greater daily weight gain (Field et al., 2006) and reduce stress-related behaviours (Hernandez-Reif et al., 2007). Another intervention called *kangaroo care* focuses on promoting skin-to-skin contact between infants and caregivers, and encouraging breastfeeding. These practices have been shown to improve the physical and psychological health of preterm infants (Conde-Agudelo et al., 2011), and are becoming widely adopted into mainstream medical practice.

The fact that teratogens can influence the development of the fetal brain—and in some cases lead to premature birth—has made parents quite vigilant about these potential dangers. As you've read in this section, these concerns are well-founded. However, it is also important that parents examine the evidence for each potential threat to see if it is credible. In Module 2.3, we briefly discussed Andrew Wakefield, a British researcher who fabricated some of his data showing a link between vaccinations and autism. In that module, we focused on the ethical violations that he committed. The Myths in Mind box illustrates how this

researcher's lapse in ethics has had a profound effect on the health and safety of tens of thousands of innocent children.

Kangaroo care—skin-to-skin contact between babies and caregivers—is now encouraged for promoting optimal infant development.

Victoria Boland Photography/Flickr/Getty Images

Sensory and Motor Development in Infancy

Listen to the Audio

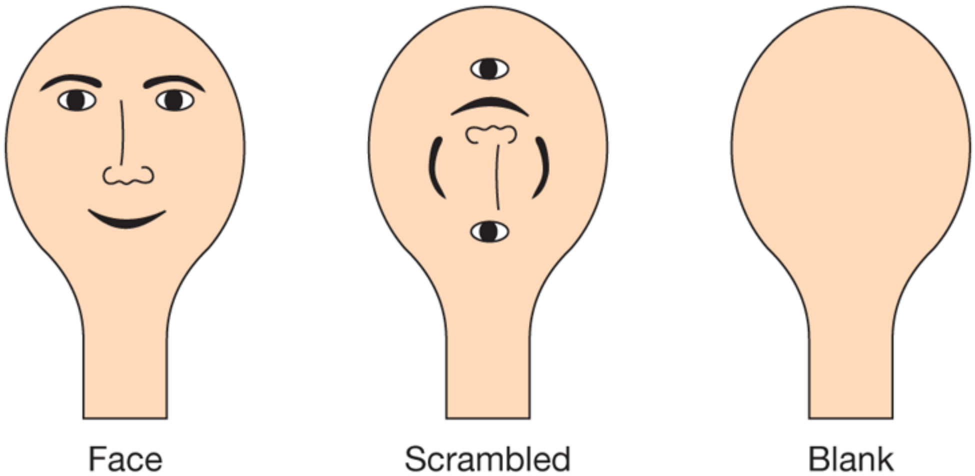
It is hard to fathom what the world of an infant must be like. As adults, we depend heavily on our top-down processes (see Module 4.1) to help us label, categorize, perceive, and make sense of the world, but infants have developed very few top-down patterns by the time they are born. Their brains are pretty close to being "blank slates," and life must be, as William James so aptly put it, a "blooming, buzzing confusion."

However, babies aren't quite as "blank" as we have historically assumed. In fact, just before the eighth month of prenatal development, infants seem to be listening and remembering sounds from outside the womb. In one study, mothers read stories out loud, including *The Cat in the Hat*, twice daily during the final six weeks of pregnancy. At birth, their babies were given a pacifier that controlled a tape recording of their mother's voice reading different stories. Babies sucked the pacifier much more to hear their mothers read *The Cat in the Hat* compared to hearing stories the moms had not read to them in the womb (DeCasper & Spence, 1986). Interestingly, newborns also show a preference for their mother's voice. For example, a study involving researchers at Queen's University showed that babies responded positively when they heard poems read by their mother, but not when the poems were read by a stranger (Kisilevsky et al., 2003). (Unfortunately for fathers, babies up to at least four months old don't prefer their dad's voice over other men's [DeCasper & Prescott, 1984; Ward & Cooper, 1999].) Perhaps the most remarkable finding is

that in the last month or so of pregnancy, infants start to pick up the speech sounds of their mother's language. In fact, a study of infants born to French or German parents discovered that babies actually cry with an accent. The cries of French babies rose in intensity toward the end of their cry while German babies started at high intensity and then trailed off. This difference was apparent at only a few days of age (Mampe et al., 2009). So, babies are actively learning about their cultural environment even while in the womb.

The visual system is not as well developed at birth, however. Enthusiastic family members may like to make goofy faces at a newborn baby, but the child isn't able to enjoy it nearly so much; newborns have only about 1/40th of the visual acuity of adults (Sireteanu, 1999), and can only see about as far away as is necessary to see their mother's face while breastfeeding (about 30 cm or less). It takes six months or more before they reach 20/20 visual acuity and it takes a full eight months before infants can perceive shapes and objects about as well as adults (Csibra et al., 2000; Fantz, 1961). Nevertheless, even newborns are highly responsive to visual cues if they're close enough to see them. They will track moving objects and will stare intently at objects they haven't seen before, although after a while they habituate to an object and lose interest in looking at it (Slater et al., 1988). Babies' visual responses to the world illustrate a major theme within psychology, which is that humans are fundamentally social creatures. Newborns prefer to look at stimuli that look like faces, compared to stimuli that have all the same features but are scrambled so that they don't look like faces (see Figure 10.3).

Figure 10.3 Experimental Stimuli for Studying Visual Habituation in Infants



Infants were shown three types of stimuli: a face-like stimulus, a scrambled face stimulus, and a neutral stimulus.

Although being exposed to a complex world is essential for the development of the human visual system, *interacting* with this world is also necessary for the visual system to properly develop. This concept was illustrated by research involving the ingenious device shown in Figure 10.4—*the visual cliff*. Originally, researchers in 1960 (Gibson & Walk, 1960) found that infants were reluctant to crawl over the deep side, seeming to understand depth and danger right from birth. However, researchers eventually discovered that only babies who had some experience crawling showed fear of the deep end (Campos et al., 1992).

Figure 10.4 The Visual Cliff

Developmental psychologists use a visual cliff (not a real one!) to test for the development of depth perception in babies. The baby shown here has not yet acquired the perceptual experience of depth.

Mark Richard/PhotoEdit, Inc.

In contrast to vision, the taste and olfactory systems are relatively well developed at birth. Similar to adults, newborns cringe when they smell something rotten or pungent (such as ammonia), and they show a strong preference for the taste of sweets. Odours are strong memory cues for infants as well. For example, infants can learn that a toy will work in the presence of one odour but not others, and they can retain this memory over several days (Schroers et al., 2007). Newborn infants can also smell the difference between their mother's breastmilk and that of a stranger. Infants even turn their heads toward the scent of breastmilk, which helps to initiate nursing (Porter & Winberg, 1999).

Motor Development in the First Year

Listen to the Audio

The beginnings of a functioning motor system are detectable a mere five months after conception when the fetus begins to make voluntary motor movements. In the last months of gestation, the muscles and nervous system are developed enough to demonstrate basic **reflexes**—*involuntary muscular reactions to specific types of stimulation*. These reflexes provide newborns and infants with the basic movements required for feeding and interacting with caregivers (see Table 10.2 for a partial list of important infant reflexes). Notice that these reflexes are highly functional; they evolved because they help the infant survive from day one, and they often begin the motor learning process that leads to the development of more complex motor skills. As the motor processes involved in these reflexes become integrated into the child's nervous system, the infant begins to gain voluntary control. That's why many of the reflexes fade away in the first six or seven months. In fact, if these reflexes persist longer than that, this may indicate neural issues that interfere with developing motor control (Volpe, 2008).

Table 10.2 A Few Key Infant Reflexes

Table 10.2 A Few Key Infant Reflexes

	THE ROOTING REFLEX
 Cathy Melloan Resources/PhotoEdit, Inc.	The *rooting reflex* is elicited by stimulation to the corners of the mouth, which causes infants to orient themselves toward the stimulation and make sucking motions. The rooting reflex helps the infant begin feeding immediately after birth.
	THE MORO REFLEX
 Petit Format/Photo Researchers, Inc./Science Source	The *Moro reflex*, also known as the "startle" reflex, occurs when infants lose support of their head. Infants grimace and reach their arms outward and then inward in a hugging motion. This may be a protective reflex that allows the infant to hold on to the mother when support is suddenly lost.
	THE GRASPING REFLEX
 Denise Hager/Catchlight Visual Services/Alamy Stock Photo	The *grasping reflex* is elicited by stimulating the infant's palm. The infant's grasp is remarkably strong and facilitates safely holding onto their caregiver.
	THE STEPPING REFLEX
 BURGER/PHANIE/Alamy Stock Photo	The *stepping reflex*, also known as the walking or dancing reflex, occurs when infants sense the onset of pressure on the sole of a foot. In fact, if you support the infant upright and gently lower the foot to a tabletop or surface, you will see the leg straighten. This reflex is the basis for learning to walk.

Over the first 12 to 18 months after birth, infants' motor abilities progress through fairly reliable stages—from crawling, to standing, to walking (see Figure 10.5). Although the majority of infants develop this way, there is still some variability; for example, some infants largely bypass the crawling stage, developing a kind of bum-sliding movement instead, and then proceed directly to standing and walking. In contrast to reflexes, the development of motor skills seems to rely more on practice and deliberate effort, which in turn is related to environmental influences, such as cultural practices. For example, Jamaican mothers typically expect

their babies to walk earlier than British or Indian mothers, and sure enough, Jamaican babies do walk earlier, likely because they are given more encouragement and opportunities to learn (Hopkins & Westra, 1989; Zelazo et al., 1993).

Figure 10.5 Motor Skills Develop in Stages

This series shows infants in different stages of development: (a) raising the head, (b) rolling over, (c) propping up, (d) sitting up, (e) crawling, and (f) walking.

Top, left: bendao/Shutterstock; top, right: Bubbles Photolibrary/Alamy Stock Photo; bottom, left: imageBROKER/Glow Images; bottom, centre left: OLJ Studio/Shutterstock; bottom, centre right: Corbis Bridge/Alamy Stock Photo; bottom, right: Eric Gevaert/Shutterstock

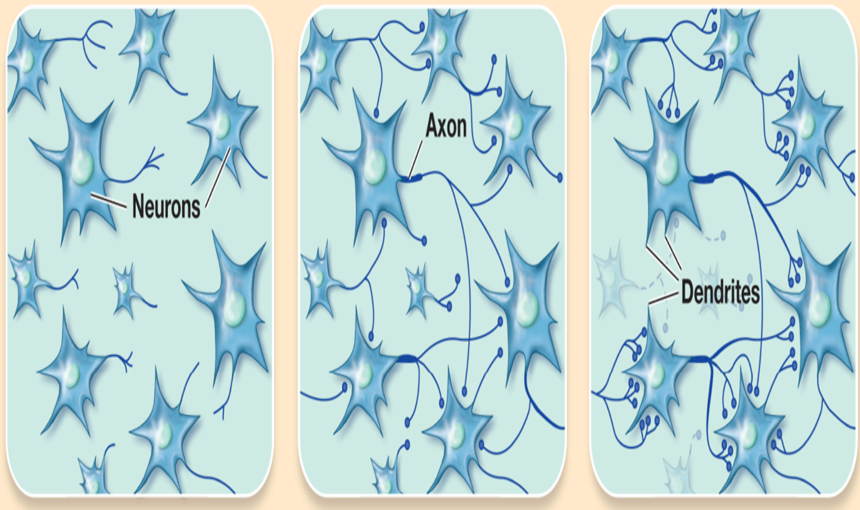
Development within the Central Nervous System

Listen to the Audio

Although all the major brain structures are present at birth, they continue developing right into adulthood. The myelination of axons (see Module 3.2), which began prenatally, accelerates through infancy and childhood, and then continues gradually for many years. Myelination of sensorimotor systems allows for the emergence of fine-tuned, voluntary motor control so that by 12 months of age, the infant has the abilities to pick up small and delicate objects, stand and balance, and even begin walking.

Two other neural processes, synaptogenesis and synaptic pruning, further help to coordinate the functioning of the developing brain. **Synaptogenesis** describes *the forming of new synaptic connections*, which occurs at blinding speed through infancy and childhood and continues through the lifespan. **Synaptic pruning**, *the loss of weak nerve cell connections*, accelerates during brain development through infancy and childhood (Figure 10.6), then tapers off until adolescence (see Module 10.3). Synaptogenesis and synaptic pruning serve to increase neural efficiency by strengthening needed connections between nerve cells and weeding out unnecessary ones.

Figure 10.6 The Processes of Synaptic Pruning



1. At birth, the infant's brain has a complete set of neurons but with relatively sparse synaptic connections.

2. During the first year, the axons grow longer, the dendrites increase in number, and a surplus of new connections is formed.

3. Over the next few years, active connections are strengthened, while unused connections are eliminated.

In summary, the journey from zygote to *you* begins dramatically, with biological pathways being formed at a breakneck pace both prenatally and after birth, giving rise to sensory and motor abilities that allow infants to become competent perceivers and actors in the external world. Most motor abilities require substantial time for infants to learn to coordinate the many different muscles involved, which depends heavily on infants' interactions with the environment. From the very beginnings of our lives, nature and nurture are inextricably intertwined.

Module 10.1 Summary

Listen to the Audio

10.1a Know . . . the key terminology related to prenatal and infant physical development.

Review Module 10.1

Start Over Swap

0/14 REVIEWED · 0 MASTERED

fetal alcohol spectrum disorders

Previous Next Got It!

10.1b Understand . . . the pros and cons of different research designs in developmental psychology.

Cross-sectional designs, in which a researcher studies a sample of people at one time, have the advantage of being faster, and generally cheaper, allowing research to be completed quickly; however, they may suffer from cohort effects because people of different ages in the sample are also from somewhat different historical time periods and, thus, any differences between them could reflect a historical process and not a developmental one. Longitudinal designs, in which a researcher follows a sample of people over a span of time, have the advantage of being able to track changes in the same people, thus giving more direct insight into developmental processes. However, such studies take longer to complete, thus slowing down the research process, and they can suffer from attrition, in which people drop out of the study over time.

10.1c Apply . . . your understanding to identify the best ways expectant parents can ensure the health of their developing fetus.

The key to healthy fetal development is ensuring a chemically ideal environment. The most important factors are adequate nutrition and avoiding teratogens. Best nutritional practices include approximately a 20% increase in the mother's caloric intake, additional protein, and ensuring sufficient quantities of essential nutrients (which usually involves taking nutritional supplements). Avoiding teratogens involves giving up smoking and drinking alcohol, and getting good medical advice concerning any medications that the expectant mother may be taking.

10.1d Analyze . . . the effects of preterm birth.

Health risks increase considerably with very premature births (e.g., those occurring at just 25 weeks' gestation). Use of proper caregiving procedures, especially personalized care that emphasizes mother–infant contact, breastfeeding, and minimal sensory stimulation for the

underdeveloped brain, increases the chances that preterm infants will remain healthy.

Module 10.2 Infancy and Childhood: Cognitive and Emotional Development

Listen to the Audio

Ulza/Shutterstock

Learning Objectives

10.2a Know . . . the terminology associated with infancy and childhood.

10.2b Understand . . . the cognitive changes that occur during infancy and childhood.

10.2c Understand . . . the importance of attachment and the different styles of attachment.

10.2d Apply . . . the concept of scaffolding and the zone of proximal development to understand how to best promote learning.

10.2e Analyze . . . how to effectively discipline children in order to promote moral behaviour.

What do tigers, helicopters, and snowplows have in common? Each describes how parents behave toward their children. These are not scientific terms, we should note, but instead they identify societal trends and views of parenting. The simple transformation of the noun parent into the verb parenting is emblematic of an ever-growing trend to categorize (and, yes, judge) the way that parents raise their children. For example, tiger parents impose strict rules and regimented schedules, and emphasize achievement in their children (think about a five-year old whose father has him drilling harder than an NHLer knowing he will one day play wing for the Oilers). Helicopter parents hover—sometimes literally—over their children to protect them from harm and to solve their problems. This could be the mother who essentially takes over her daughter's science fair project, bringing all kinds of electronics and robotics home from her engineering firm. Snowplows, on the other hand, simply remove any possible challenges and barriers to their child's success. These parents may have made dozens of phone calls and visits to their children's summer camp before it started, leaving special instructions and placing demands on the counsellors for the appropriate way to treat their little angels. These three parenting types do share a common theme: most parents simply want to do well by their children. But with so many approaches to parenting, we have to

wonder how parents' choices and behaviour influence the child's social, emotional, and cognitive development.

The transition from baby to toddler is one of the most biologically and behaviourally dramatic times in a person's life. Within a few years, we grow from highly incapable, drooling babies to highly coordinated and capable children. The physical, cognitive, and social transitions that occur between infancy and childhood are remarkably ordered, yet are also influenced by individual genetic and sociocultural factors. In this module, we integrate some important stage perspectives to explain psychological development through childhood.

One key insight to emerge from several lines of research is that for many systems, certain periods of development seem to be exceptionally important for long-term functioning. A **sensitive period** *is a window of time during which exposure to a specific type of environmental stimulation is needed for normal development of a specific ability*. For example, to become fluent in language, infants need to be exposed to speech during their first few years of life. Long-term deficits can emerge if the needed stimulation, such as language, is missing during a sensitive period. Sensitive periods of development are a widespread phenomenon. They have been found in humans and other species for abilities such as depth perception, balance, recognition of parents, and, in humans at least, identifying with a particular culture (Cheung et al., 2011). However, although sensitive periods can explain the emergence of many perceptual (and some cognitive) abilities, they are only one of many mechanisms underlying human development.

Over the past century, many psychologists have attempted to explain how children's mental abilities develop and expand. One of the most influential figures in this search was a Swiss psychologist named Jean Piaget (1896–1980).

Cognitive Changes: Piaget's Cognitive Development Theory

Listen to the Audio

Jean Piaget developed many of his theories in an unorthodox manner: he studied his own family. However, this research was not done in a casual manner. Piaget actively studied, made copious notes of his observations, and even ran specific tests and measurements on his own children as they were growing up. The theories that resulted from this extensive personal project laid much of the groundwork for the modern science of **cognitive development**—*the study of changes in memory, thought, and reasoning processes that occur throughout the lifespan*. In his own work, Piaget focused on cognitive development from infancy through early adolescence.

Piaget's central interest was in explaining how children learn to think and reason. According to Piaget, learning involves two central processes, which he named assimilation and accommodation. **Assimilation** is *fitting new information into the belief system you already possess*. For example, young children may think that all girls have long hair and, as they encounter more examples of this pattern, they will assimilate them into their current understanding. Of course, eventually they will run into girls with short hair or boys with long hair, and their beliefs will be challenged by this information. They may, at first, misunderstand, assuming a short-haired girl is actually a boy and a long-haired boy is actually a girl. But over time they will learn that their rigid categories of long-haired girl and short-haired boy need to be altered. This change is called **accommodation**, *a creative process whereby people modify their belief*

structures based on experience. Our belief systems help us make sense of the world and acquire new facts and examples of what we already know (assimilation). However, as we encounter information that challenges our beliefs, we struggle to assimilate it. Therefore, we may need to develop a more complex understanding of the world (accommodation).

Based on his observations of his children, Piaget concluded that there was more to cognitive development than just repeated assimilation and accommodation. Instead, he proposed that children pass through four distinct *stages* from birth through early adolescence: the sensorimotor, preoperational, concrete operational, and formal operational stages. Within a stage, the child may continue assimilating and accommodating new facts and observations. Passing from one stage into the next occurs when the child achieves the important developmental milestone of that stage, and can now think in a fundamentally different way (see Table 10.3). As you will see, the most profound examples of these major developmental changes come early in life, although abilities can continue to develop into adulthood.

Table 10.3 Piaget's Stages of Cognitive Development

Table 10.3 Piaget's Stages of Cognitive Development

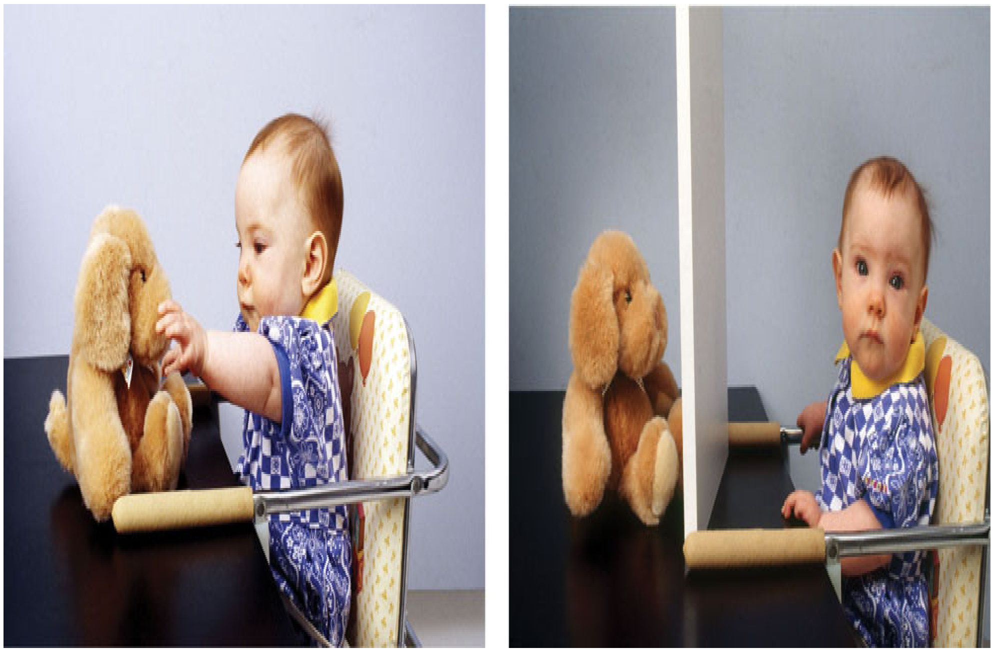
Stage	Description
Sensorimotor (0–2 years)	Cognitive experience is based on direct sensory experience with the world, as well as motor movements that allow infants to interact with the world. Object permanence is the significant developmental milestone of this stage.
Preoperational (2–7 years)	Thinking moves beyond the immediate appearance of objects. The child understands physical conservation and that symbols, language, and drawings can be used to represent ideas.
Concrete operational (7–11 years)	The ability to perform mental transformations on objects that are physically present emerges. Thinking becomes logical and organized.
Formal operational (11 years–adulthood)	The capacity for abstract and hypothetical thinking develops. Scientific reasoning becomes possible.

The Sensorimotor Stage: Living in the Material World

Listen to the Audio

The earliest period of cognitive development is known as the **sensorimotor stage**; *this stage spans from birth to two years, during which infants' thinking about and exploration of the world are based on immediate sensory (e.g., seeing, feeling) and motor (e.g., grabbing, mouthing) experiences*. During this time, infants are completely immersed in the present moment, responding exclusively to direct sensory input. For an infant in this stage, as soon as an object is out of sight and out of reach, it will cease to exist.

This is obviously not how the world works. Thus, the first major milestone of cognitive development proposed by Piaget is **object permanence**, *the ability to understand that objects exist even when they cannot be directly perceived*. To test for object permanence, Piaget would allow an infant to reach for a toy, and then place a screen or a barrier between the infant and the toy so that the toy was no longer visible to the infant. If the reaching or looking stopped, it would suggest that the infant did not have a mental representation of the object when it was not visible, thus indicating that the infant had not yet developed object permanence. But for the child that has developed object permanence, think how different the world has just become. The ability to represent objects in memory is one of the foundations of being able to think about the past or what might be in the future.



Object permanence is tested by examining reactions that infants have to objects when they cannot be seen. Children who have object permanence will attempt to reach around the barrier or will continue looking in the direction of the desired object.

Doug Goodman/Photo Researchers, Inc./Science Source

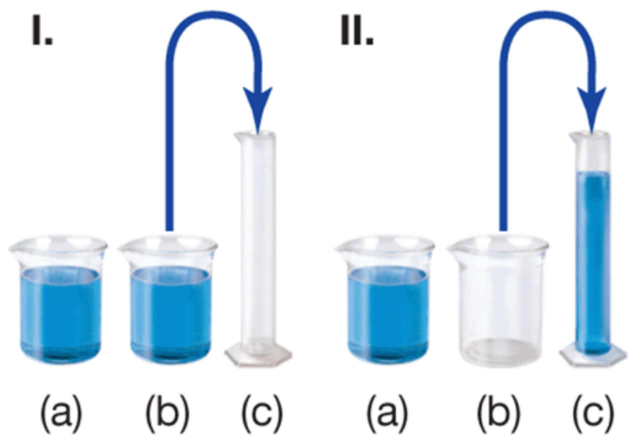
The Preoperational Stage: Quantity and Numbers

Listen to the Audio

According to Piaget, once children have mastered sensorimotor tasks, they have progressed to the **preoperational stage** , *which spans ages two to seven and is devoted to language development, the use of symbols, pretend play, and mastering the concept of conservation* (to be discussed next). During this stage, children can think about physical objects, although they have not quite attained abstract thinking abilities. They may count objects and use numbers, yet they cannot mentally manipulate information or see things from other points of view.

This inability to manipulate abstract information is shown by testing a child's understanding of **conservation**, *the knowledge that the quantity or amount of an object is not the same as the physical arrangement and appearance of that object*. Conservation can be tested in a number of ways (see Figure 10.7). For example, in a *conservation of liquid* task, a child is shown two identical glasses, each containing the same amount of liquid. The researcher then pours the liquid from one glass into a differently shaped container, typically one that is taller and narrower. Although the amount of liquid is still the same to an adult, many children believe that the tall, thin glass contains more fluid because it looks "bigger." It appears that the concept and word *mor* means size to the child, but numbered units of volume or weight to an adult. You can see this same principle at work in the *conservation of number* task (see the two rows of coins in Figure 10.7).

Figure 10.7 Testing Conservation



A child views two equal amounts of fluid, one of which is then poured into a taller container. Children who do not yet understand conservation believe that there is more fluid in the tall, narrow container compared to the shorter one.

1 of 2

Previous Next

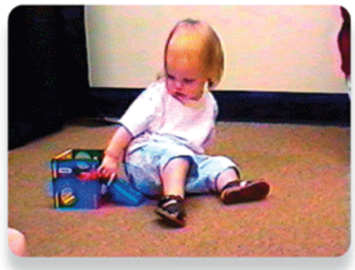
Source: Lilienfeld, Scott O.; Lynn, Steven J; Namy, Laura L.; Woolf, Nancy J., *Psychology: From Inquiry to Understanding*, 2nd Ed., 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

Tests of conservation demonstrate the limits of children’s cognitive abilities. However, continuing research has shown that in some cases, these limitations are more a matter of the child’s interpretation of an activity or the abstract, trivial nature of the task (see the Working the Scientific Literacy Model feature). For example, three-year-old children seem to misinterpret the concept of “how many” to mean “how long” in the coin task (Figure 10.7). But replace those pennies with M&Ms, and suddenly the context is much more interesting. If you put more M&Ms tightly packed together so they take up less space than a line of M&Ms that is more spread out, children will pick the more tightly packed but “smaller” row, understanding that it contains more candy—especially if

they get to eat the candy from the row they choose (Mehler & Bever, 1967).

Another challenge aspect of quantity and size can be revealed in studies of *scale errors* in which children struggle to match shapes and sizes in abstract thought (DeLoache et al., 2004). In Figure 10.8, for example, you can see how a child interacts with a toy car as if it were a real life-sized vehicle. He can identify it as a car, but fails to realize that he is too big to take it for a spin until he actual tries it. By two to two-and-a-half years of age, scale errors decline as children begin to understand properties of objects and how they are related. For example, in Figure 10.8c, a child is able to understand that researchers have duplicated a room—it's just that one is a doll house and the other is human-sized. By realizing the difference is just a matter of scale, the child is able to transfer knowledge from one version of the room to another.

Figure 10.8 Scale Errors and Testing for Scale Model Comprehension



(a)

(b)

(c)

The children in photos (a) and (b) are making scale errors. One child is attempting to slide down a toy slide and another is attempting to enter a toy car. Three-year-olds understand that a scale model represents an actual room (c). The adult pictured is using a scale model to indicate the location of a hidden object in an actual room of this type. At around three years of age, children understand that the scale model symbolizes an actual room and will go directly to the hidden object after viewing the scale model.

Courtesy of Judy DeLoache

The Concrete Operational Stage: Using Logical Thought

Listen to the Audio

Having developed the preliminary abilities of abstract representation (object permanence), quantity (conservation), and scale, children are prepared to solve increasingly complex problems at around age seven. In the **concrete operational stage** *(ages seven to 11 years), children develop skills in logical thinking and manipulating numbers*. Their thinking becomes increasingly logical and organized. For example, a child in the concrete operational stage can handle a concept known as the *transitivity property*,

- If I have more M&Ms than my brother
- But my sister has even more M&Ms than me
- Then my sister also has more M&Ms than my brother

Using a specific example of M&Ms, the concrete operational child is usually able to solve these problems. However, the "concreteness" of this stage means that it is still important to have real, physical problems (and real M&Ms in this case) rather than abstract meanings. It's not that the M&Ms must be present for all 10-year-olds to understand transitivity—although it certainly is important early on in concrete operations. The important thing later in the stage is that the M&Ms are tangible objects that anyone with object permanence can easily imagine, even if they are not present. On the other hand, there are plenty of adults beyond this stage who still get tripped up when encountering completely abstract versions of the exact same transitivity scenario as above, but in

completely abstract terms: X is more than B, and L is less than B, then clearly X is more than L. This ability to apply logical operations (such as comparisons) about physical objects sets the stage for reasoning abstractly in the fourth and final stage of cognitive development.

The Formal Operational Stage: Abstract and Hypothetical Thought

Listen to the Audio

The **formal operational stage** *(ages 11 to adulthood) involves the development of advanced cognitive processes such as abstract reasoning and hypothetical thinking*. In this stage, adolescents and adults are able to reason about abstract things, including solving transitivity problems with abstract variables. In fact, this stage is when many North American students get their first exposure to pre-algebra courses. Algebra is a great example of abstract reasoning. Scientific thinking, such as gathering evidence and systematically testing possibilities, is also characteristic of this stage. To generate hypotheses, for example, you must be able to imagine a hypothetical scenario in which you could be proven wrong (see falsifiability in Module 2.1). One difficulty in that is that a scientist must be willing to accept statements they do not believe are true. Imagine the following exchange between a psychologist and a child.

- If this feather hits glass, the glass will break.
- If this feather hits a window, what will happen?

In the formal operational stage, the young adolescent would not believe the first statement. However, if told to accept it as true, they could say that the feather would actually break the glass. That would be the logical consequence if the first statement was, in fact, true. In the concrete operational stage, children cannot complete the logic operation that runs counter to their own experiences and beliefs. Substitute a hammer for the

feather, however, and a the same child will have no trouble coming up with the correct answer.

Piaget's theories have had a lasting impact on modern developmental psychology. In addition to providing insights into the minds of young children, Piaget's work inspired numerous other researchers to study cognitive development. Many of these new discoveries complement, rather than entirely contradict, Piaget's foundational work.

Working the Scientific Literacy Model

Evaluating Piaget

Listen to the Audio

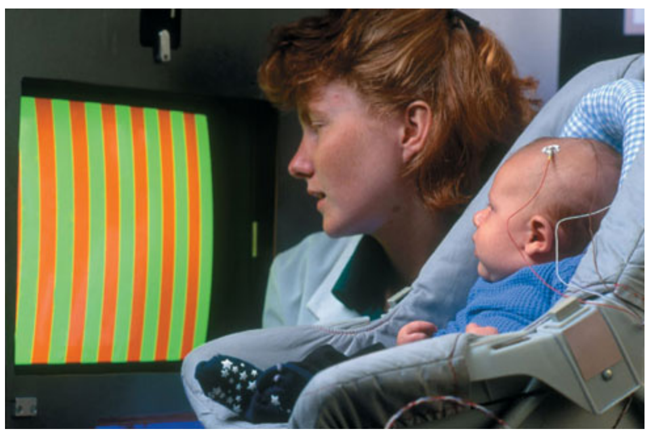
Piaget was immensely successful in opening our eyes to the cognitive development of infants and children. Nevertheless, advances in testing methods have shown that he may have underestimated some aspects of infant cognitive abilities. In fact, infants appear to understand some basic principles of their physical and social worlds very shortly after birth.

What do we know about cognitive abilities in infants?

The **core knowledge hypothesis** proposes that *infants have inborn abilities for understanding some key aspects of their environment* (Spelke & Kinzler, 2007). It is a bold claim to say that babies know something about the world before they have even experienced it, so we should closely examine the evidence for this hypothesis.

How can *we* know what infants know or what they perceive? Piaget developed tasks requiring behavioural responses that indicated comprehension, or lack thereof, of capacities such as object permanence. However, infants have a very limited behavioural repertoire. The habituation–dishabituation response has opened up many opportunities to study infant cognitive abilities. **Habituation** *refers to a decrease in responding with*

repeated exposure to an event. For example, if an infant is shown the same stimulus over and over, they will stop looking at it. Conversely, infants are quite responsive to novelty or changes in their environment. Thus, if the stimulus suddenly changes, the infant will display **dishabituation**, *an increase in responsiveness with the presentation of a new stimulus*. In other words, the infant will return their gaze to the location that they previously found boring. Research on habituation and dishabituation in infants led to the development of measurement techniques based on what infants will look at and for how long. These techniques now allow researchers to test infants even younger than Piaget was able to.



A popular method for testing infant cognitive abilities is to measure the amount of time infants look at stimuli. Researchers measure habituation and dishabituation to infer what infants understand.

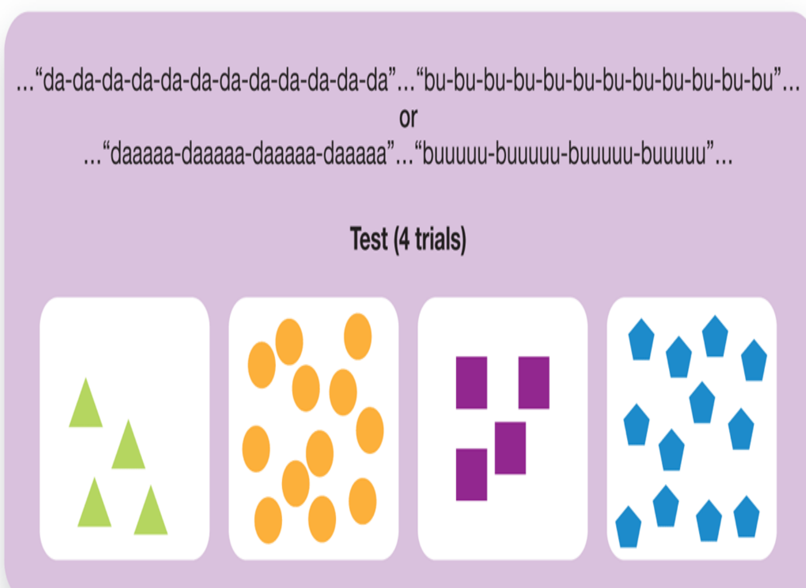
Lawrence Migdale/Photo Researchers, Inc./Science Source

How can science help explain infant cognitive abilities?

Measurement techniques based on what infants look at have been used to measure whether infants understand many different concepts, including abstract numbers—an ability that most people

imagine appears much later in development. For example, Elizabeth Spelke and colleagues conducted a study in which 16 infants just *two days old* were shown sets of either 4 or 12 identical small shapes (e.g., yellow triangles, purple circles) on a video screen. The researchers also made a sound 4 or 12 times (e.g., tu-tu-tu-tu or ra-ra-ra-ra-ra-ra-ra-ra-ra-ra-ra-ra) at the same time they showed the shapes (see Figure 10.9). Researchers varied whether the number of shapes the infants saw matched the number of tones they heard (e.g., 4 yellow triangles and 4 "ra" tones) or not (e.g., 4 purple circles and 12 "ra" tones). The infants were most attentive when what they saw and heard matched. In other words, they looked longer at the shapes when the number of shapes matched the number of sounds, compared to when they did not match; this result is taken as evidence that even very young infants have a rudimentary appreciation for abstract numbers (Izard et al., 2009).

Figure 10.9 Testing Infants' Understanding of Quantity



In this study, infants listened to tones that were repeated either 4 or 12 times while they looked at objects that had either 4 or 12 components. Infants spent more time looking at visual arrays when the number of items they saw matched the number of tones they heard.

Source: Figure 1 from Izard, V., Sann, C., Spelke, E. S., & Streri, A. (2009). Newborn infants perceive abstract numbers. *Proceedings of the National Academy of Sciences*, *106*, 10382–10385.

Can we critically evaluate this research?

Many of the studies of early cognitive development discussed in this module used the "looking time" procedure, although not all psychologists agree that it is an ideal way of determining what infants understand or perceive (Aslin, 2007; Rivera et al., 1999). We cannot know exactly what infants are thinking, and perhaps they look longer at events and stimuli simply because these are more interesting rather than because they understand anything in particular about them. Inferring mental states that participants cannot themselves validate certainly leaves room for alternative explanations.

Also, the sample sizes in these studies are often fairly small, due to the cost and complexity of researching infants. In the study of shapes and tones just described, only 16 infants managed to complete the study. Forty-five others were too fussy or sleepy to successfully finish the task.

Why is this relevant?

The key insight provided by this research is that cognitive development in young infants is much more sophisticated than psychologists previously assumed. With each study that examines the cognitive capacities of infants, we learn that infants are not just drooling blobs of flesh that need to be fed and diapered—though it certainly can feel that way when you are a new parent.

Now we are learning that infants can understand more than we might expect, and can reason in more complex ways than we had believed.

One thing that parents and caregivers can learn from this research is to see their children as complex learners who use sensation and movement to develop their emerging cognitive abilities. Caregivers can encourage this process by talking to them using diverse vocabulary, exploring rhythm and music, allowing them to feel different objects, and exposing them to different textures and sensations.

Watch Habituation

Complementary Approaches to Piaget

Listen to the Audio

In the many decades since Piaget's work, psychologists have explored how children's social contexts affect their cognitive development. For example, in a learning context, other people can support and facilitate children's learning, or can make it more difficult. Children who try to master a skill by themselves may run into obstacles that would be easier to overcome with a little assistance or guidance from another person, or they may give up on a task when a little encouragement could have given them the boost needed to persevere and succeed. At the opposite extreme, children who have everything done for them and who are not allowed to work through problems themselves may become relatively incapable of finding solutions on their own, and may not develop feelings of competence that support striving for goals and overcoming challenges. Therefore, optimal development occurs somewhere between the extremes of children doing everything on their own without any support, and having others over-involved in their activities.

Russian psychologist Lev Vygotsky (1978) proposed that *development is ideal when children attempt skills and activities that are just beyond what they can do alone, but they have guidance from adults who are attentive to their progress;* this concept is termed the **zone of proximal development** (Singer & Goldin-Meadow, 2005). Teaching in order to keep children in the zone of proximal development is called **scaffolding**, *a highly attentive approach to teaching in which the teacher matches guidance to the learner's needs*.

Cross-cultural research on parent–infant interactions shows that scaffolding is exercised in different ways (Rogoff et al., 1993). For example, in one study, 12- to 24-month-old children were offered a toy that required pulling a string to make it move. Parents from Turkey, Guatemala, and the United States were observed interacting with their infants as they attempted to figure out how the toy worked. All parents used scaffolding when they spoke and gestured to their children to encourage them to pull the string, but mother–child pairs from Guatemala were much more communicative with each other, both verbally and through gestures such as touching and using the direction of their gaze to encourage the behaviour. Over time, this kind of sensitive scaffolding should result in children who are more seamlessly integrated into the daily life of the family and community, rather than merely relegated to "play" activities in specialized "kid-friendly" environments. This means that children who are appropriately scaffolded are able to be useful and self-sufficient at much earlier ages than is usual in contemporary North American society.

Caregivers who are attentive to the learning and abilities of a developing child provide scaffolding for cognitive development.

Nolte Lourens/Shutterstock

#Psych

Screen Time

Screen time, the amount of time spent with eyes locked on any type of digital screen (phone, tablet, computer, television), is a relatively new phrase and is also a well-known source of any combination of shame, relief, frustration, and worry for many parents. An exhausted parent allowing their two-year-old to flip through selfies while waiting at the pediatrician's office will likely draw scorn from other parents (and possibly their pediatrician). Is this two-year-old "digital native" destined to become glued to a screen for life, unable to explore the outside world or have a face-to-face interaction with another human being? This is of course the fear that many parents have. Unfortunately, there are no definitive scientific answers as to whether screen time has any long-term negative effects on brain and cognitive development. However, we can consider potential risks (and benefits). Perhaps the greatest risk is that the time spent on the screen is simply lost opportunity. Generally speaking, digital media do not offer learning opportunities that infants and toddlers can adequately absorb, especially the type of scaffolding described earlier. From that perspective, screens are definitely inferior to direct face-to-face interaction with another person (Canadian Paediatric Society, 2017; Radesky et al., 2015). Screens are also habit forming, which can be observed from a very early age (just watch Dad or Mom as they pry their phone from their little one's hands). On the other hand, well-designed educational

apps can be of high educational value if they are designed well and used with the right age groups. The best ones are those that promote active, engaged, meaningful, and socially interactive learning opportunities (Hirsh-Pasek et al., 2015). Given the ubiquity of screens, concerns about their potential effects on social and cognitive development won't go away any time soon.

Social Development, Attachment, and Self-Awareness

Listen to the Audio

Infants are profoundly dependent on their caregivers for pretty much everything, from food to relief from dirty diapers. Human contact is also critical during infancy; being touched and held, seeing facial expressions, and hearing familiar voices are all important, not just for helping infants to feel secure but also to thrive physically and psychologically. In the mid-20th century, such claims were seen as unscientific. We now know, however, that early relationships can affect the developing child in ways that last for the rest of their lives.

Understanding the intense social bonding that occurs between humans revolves around the central concept of **attachment**, *the enduring emotional bond formed between individuals, initially between infants and caregivers*. Attachment motivations are deeply rooted in our psychology, compelling us to seek out others for physical and psychological comfort, particularly when we feel stressed or insecure (Bowlby, 1951). Infants draw upon a remarkable repertoire of behaviours that are geared toward seeking attachment, such as crying, cooing, gurgling, and smiling, and adults are generally responsive to these rudimentary but effective communications.

What *Is* Attachment?

Listen to the Audio

In the early decades of modern psychology, dominant theories of motivation emphasized biological drives, such as hunger and thirst, that motivated people to satisfy their basic needs. From this perspective, the motivation that drove infants to connect with caregivers, like their mother, was simple; their mother fed them, reducing their hunger, and thus, they developed a behavioural interdependence with their mother, and through basic conditioning processes (i.e., associating their mother with the pleasure and comfort of food), formed an emotional attachment with their mother as well. Such a description of love is never going to fill a book of poetry, but it seemed to scientifically and objectively account for the infant–caregiver bond.

However, in the 1950s, a psychologist named Harry Harlow made an extremely interesting observation, although one so seemingly innocuous that most of us likely would have overlooked it. Harlow was conducting research on infant rhesus monkeys, and was raising these monkeys in cages without any contact with their mothers. In the course of this research, he noticed that the baby monkeys seemed to cling passionately to the cloth pads that lined their cages, and they would become very distressed when these pads were removed for cleaning. This simple observation made Harlow start to wonder what function the pads served for the monkeys. The monkeys didn't eat the pads, obviously, so why should they be so attached to them?

A baby monkey clings to a cloth-covered object—Harlow called this object the *cloth mother*—even though in this case the wire “mother” provided food.

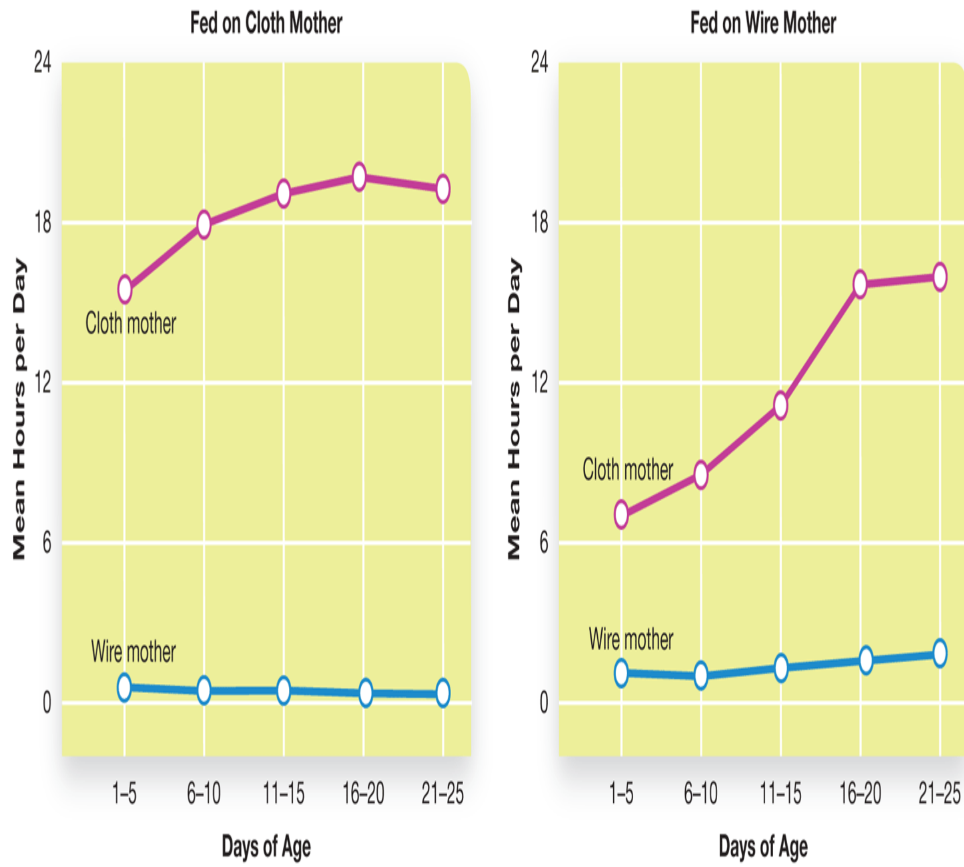
Nina Leen/The LIFE Picture Collection/Getty Images

Harlow designed an ingenious set of studies, testing whether it was physical comfort or primary drive reduction that drove the formation of attachment. He placed rhesus monkeys in cages, right from birth, and gave them two pseudo-mothers: one was a cylinder of mesh wire wrapped with soft terry-cloth, loosely resembling an adult monkey; the other was an identical cylinder but without the cloth covering. To then test whether reducing the monkeys’ hunger was important for the formation of attachment, Harlow simply varied which of the “mothers”

was the food source. For some monkeys, the wire mother had a bottle affixed to it and thus was the infant's food source, whereas for other monkeys, the bottle was affixed to the cloth mother. The question was, who would the monkeys bond with? Did their emotional attachment actually depend on which of the "mothers" fed them?

The contest between mothers wasn't even close. No matter who had the bottle, the baby monkeys spent almost all their time with the cloth mother, pretty much ignoring the wire mother except for the small amount of time they spent actually feeding, when she had the bottle (see Figure 10.10). Furthermore, the monkeys seemed emotionally attached to the cloth mother, depending on her to meet their emotional needs. For example, researchers devised experiments in which the baby monkeys would be frightened (e.g., surprising them with a metallic contraption that looked like a vicious monster), and they would watch which mother the infants would run to for comfort and security. Over and over again, they ran to the cloth mother. The implications were clear—attachment is not about reducing fundamental biological drives; it's about feeling secure, which has a strong basis in feeling physically comforted. Furthermore, if the process of attachment is a traumatic one, such as in the case of parent-infant abuse, long-term maladaptive changes in the brain circuitry supporting emotional responding and regulation occur (Opendak et al., 2017).

Figure 10.10 Harlow's Monkeys: Time Spent on Wire and Cloth Mother Surrogates



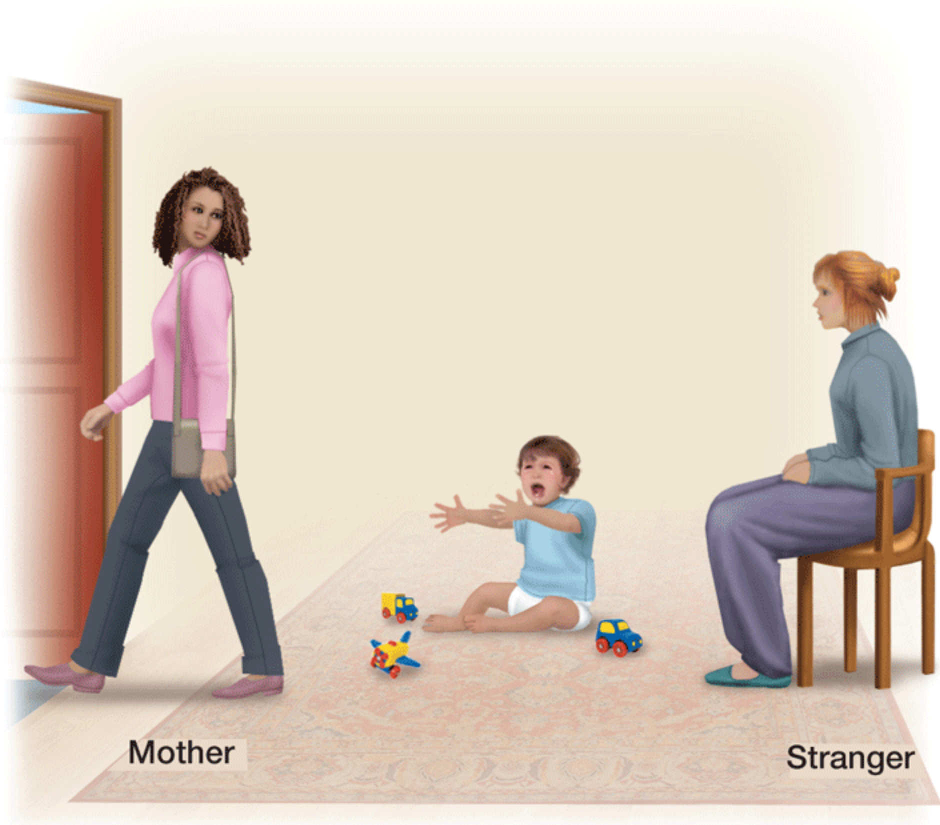
Source: Harlow, H. F. (1958). The nature of love. *American Psychologist*, *13*(12), 673–685. From the American Psychological Association.

Types of Attachment

Listen to the Audio

Obviously, it would be unethical to raise human babies in cages with fake mothers and frightening noises. Therefore, psychologists employ methods of studying infant attachment that are only mildly stressful and mimic natural situations such as *stranger anxiety*—signs of distress that infants begin to show toward strangers at about eight months of age. One such method, developed by Mary Ainsworth (1978), is known as **strange situation test**, *a way of measuring infant attachment by observing how infants behave when exposed to different experiences that involve anxiety and comfort*. The procedure involves a sequence of scripted experiences that expose children to mild anxiety (e.g., the presence of a stranger, being left alone with the stranger), and the potential to receive some comfort from their caregiver. For example, the child and caregiver spend a few minutes in a room with some toys; a stranger enters, the caregiver leaves, and then the caregiver returns. In each segment of the procedure, the child's behaviour is carefully observed. Ainsworth noted three broad patterns of behaviour that she believed reflected three attachment styles (see Figure 10.11):

Figure 10.11 The Strange Situation



Studies of attachment by Mary Ainsworth involved a mother leaving her infant with a stranger. Ainsworth believed that the infants' attachment styles could be categorized according to their behavioural responses to the mother leaving and returning.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed., © 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

1. *Secure attachment*. The caregiver is a secure base that the child turns toward occasionally, "checking in" for reassurance as they explore the room. The child shows some distress when the caregiver leaves, and avoids the stranger. When the caregiver returns, the child seeks comfort and their distress is relieved.
2. *Insecure attachment*. Two subtypes were distinguished:
   - *Anxious/Ambivalent*. The caregiver is a base of security, but the child depends too strongly on the caregiver, exhibiting

    "clingy" behaviours rather than being comfortable exploring the room on his own. The child is very upset when the caregiver leaves, and is quite fearful toward the stranger. When the caregiver returns, the child seeks comfort, but then also resists it and pushes the caregiver away, not allowing their distress to be easily alleviated.
  - *Avoidant*. The child behaves as though they do not need the caregiver at all, and plays in the room as though oblivious to the caregiver. The child is not upset when the caregiver leaves, and is unconcerned about the stranger. When the caregiver returns, the child does not seek contact.
3. Subsequent research identified a fourth attachment style, *disorganized* (Main & Solomon, 1990), which is best characterized by instability; the child has learned (typically through inconsistent and often abusive experiences) that caregivers are sources of both fear and comfort. The child experiences a strong ambivalence, and reinforces this through inconsistent behaviour, seeking closeness and then pulling away, or often simply "freezing," paralyzed with indecision.

Attachment is important throughout one's life. The specific patterns of behaviour that characterize different attachment styles can even be seen, albeit in somewhat more complex forms, in adult relationships (Hazan & Shaver, 1987; Mikulincer & Shaver, 2007). Attachment styles predict many different relationship behaviours, including how we form and dissolve relationships, specific issues and insecurities that arise in relationships, and likely patterns of communication and conflict. For example, in one large, longitudinal study spanning more than 20 years, people who were securely attached as infants were better able to recover from interpersonal conflict with their romantic partners (Salvatore et al., 2011). It appears that the father described at the beginning of Module 10.1 was correct; we really are similar to "giant babies."

Parenting and Attachment

Listen to the Audio

In humans, the tension between helping others versus being concerned for ourselves reflects a kind of tug-of-war between two psychobiological systems: the **attachment behavioural system**, *which is focused on meeting our own needs for security*, and the **caregiving behavioural system**, *which is focused on meeting the needs of others*. Each system guides our behaviour when it is activated; however, the attachment system is primary, and if it is activated, it tends to shut down the caregiving system. What this means in everyday experience is that if a person feels insecure, it will be hard for them to take others' needs into consideration. However, if attachment needs are fulfilled, then the caregiving system responds to others' distress, motivating the person to care for others (Mikulincer & Shaver, 2005). Thus, raising kind, moral children is about helping them feel loved and secure, not just teaching them right from wrong.

Faced with the constant challenge of managing their children's behaviour, parents commonly turn to the principles of operant conditioning, using rewards (e.g., Smarties, physical affection, loving words) and punishments (e.g., angry tone of voice, time-outs, criticism) as necessary. It seems like common sense, so how could it be a problem? These *conditional approaches* (i.e., rewards and punishments that are applied in certain conditions) can have significant unintended consequences. Although conditional approaches often produce the desired behaviours, these behaviours don't tend to persist over the long term if the child does not understand the parents' reasoning (Deci at al., 1999). Further, when

parents aren't around to administer rewards or punishments, children may find it difficult to "do the right thing."

Finally, conditional parenting can impact children's self-esteem and emotional security. Because children learn to associate feeling good about themselves with the experience of receiving rewards and avoiding punishment, their self-esteem becomes more dependent upon *external* sources of validation. Children who experience their parents' regard for them as conditional report more negativity and resentment toward their parents; they also feel greater internal pressure to do well, which is called **introjection**, *the internalization of the conditional regard of significant other*s (Assor et al., 2004). Unfortunately, the more that people motivate themselves through introjection, the more unstable their self-esteem (Kernis et al., 2000), and the worse they tend to cope with failure (Grolnick & Ryan, 1989).

So what works better? Research clearly shows that moral development and healthy attachment is associated with **inductive discipline**, *which involves explaining the consequences of a child's actions on other people, activating empathy for others' feelings* (Hoffman & Saltzsein, 1967). Providing a rationale for a parent's decisions, showing empathy and understanding of the child's emotions, and allowing the child choice whenever possible all promote positive outcomes such as increased self-control, perseverance, and internalization of moral values (Deci et al., 1994; Patrick & Gibbs, 2012). When it comes to raising moral children, the "golden rule" seems to apply just as well—do unto your children as you would have someone do unto you.

In the next section we will learn how parental sensitivity to the emotional needs of children is connected to the development of self-awareness, as well as to the ability to take other people's perspectives.

Self-Awareness

Listen to the Audio

Between 18–24 months of age, toddlers begin to gain **self-awareness**, *the ability to recognize one's individuality*. The presence of self-awareness is typically tested by observing infants' reactions to their reflection in a mirror or on video (Bahrick & Watson, 1985; Bard et al., 2006). Self-awareness becomes increasingly sophisticated over the course of development, progressing from the ability to recognize themself in a mirror to the ability to reflect on their own feelings, decisions, and appearance. By the time children reach their fifth birthday, they become self-reflective, show concern for others, and are intensely interested in the causes of other people's behaviour.

By two years of age, toddlers can recognize themselves in mirrors.

Melpomen/123RF

Young children are often described as **egocentric**, *meaning that they only consider their own perspective* (Piaget & Inhelder, 1956). This definition does not imply that children are selfish or inconsiderate, but that they merely lack the cognitive ability to understand the perspective of others. For example, a two-year-old may attempt to hide by simply covering their own eyes. From their perspective, they *are* hidden. Piaget believed that children were predominantly egocentric until the end of the preoperational phase (ending around age seven). He tested for egocentrism by sitting a child in front of an object, and then presenting pictures of that object from four angles. While sitting opposite the child, Piaget would ask them to identify which image represented the object from Piaget's own perspective. Children's egocentricity was demonstrated by selecting the image corresponding to their own perspective, rather than being able to imagine what Piaget would be seeing (Figure 10.12).

Figure 10.12 Piaget's Test for Egocentric Perspective in Children

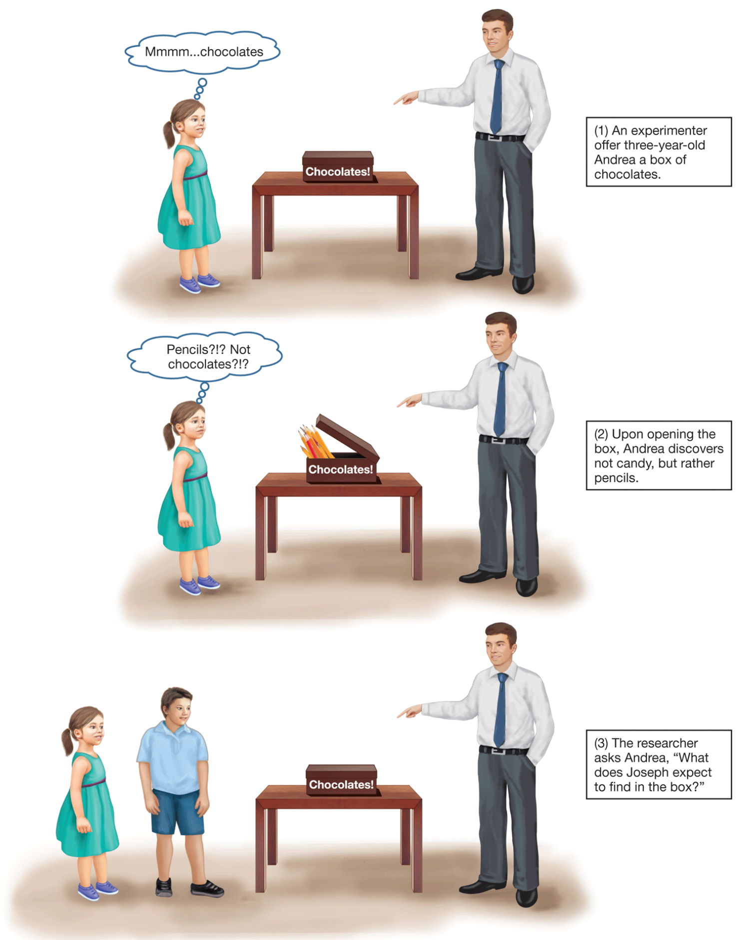
Piaget used the three-mountain task to test whether children can take someone else's perspective. The child would view the object from one perspective while another person viewed it from a different point of view. According to Piaget, children are no longer exclusively egocentric if they understand that the other person sees the object differently.

Modern research indicates that children take the perspective of others long before the preoperational phase is complete. Perspective taking in young children has been demonstrated in studies of **theory of mind**—*the ability to understand that other people have thoughts, beliefs, and perspectives that may be different from one's own*. Consider the following scenario:

> An experimenter offers three-year-old Andrea a box of chocolates. Upon opening the box, Andrea discovers not candy, but rather pencils. Joseph enters the room and she watches as Joseph is offered the same box. The researcher asks Andrea, "What does Joseph expect to find in the box?"

If Andrea answers “pencils,” this indicates that she believes Joseph knows the same thing she does. However, if Andrea tells the experimenter that Joseph expects to see chocolates, it demonstrates that she is taking Joseph’s mental perspective, understanding that he does not possess her knowledge that the “chocolate box” actually contains pencils (Lillard, 1998; Wimmer & Perner, 1983). Children typically pass this test at ages four to five, although younger children may pass it if they are told that Joseph is about to be tricked (Figure 10.13). Of course, the shift away from egocentric thought does not occur overnight. Older children may still have difficulty taking the perspective of others; in fact, even adults aren’t that great at it much of the time. Maintaining a healthy awareness of the distinction between self and other, and accepting the uniqueness of the other person’s perspective, is a continual process.

Figure 10.13 A Theory-of-Mind Task



There are different methods of testing false beliefs. In this example, Andrea is asked what she thinks Joseph expects to find in the "chocolate box." If she has developed theory-of-mind skills, she will be able to differentiate between her knowledge of the box's contents (pencils) and what Joseph would expect to find (chocolates).

Psychological research now indicates that self-awareness and theory of mind are in constant development right from birth. Early in children's lives, emotions are often experienced as chaotic, overwhelming, and unintegrated combinations of physical sensations, non-verbal representations, and ideas. As caregivers respond to children's emotions, the children learn how to interpret and organize their emotions; this helps them become more aware of their own feelings (Fonagy & Target, 1997). As children gain the ability to understand their internal states with

greater clarity, it enhances their ability to represent the mental states of others.

This process helps to explain why it is important that caregivers not over-identify with a child's emotions. If their emotional exchange is completely synchronized (e.g., the child experiences fear and the adult also experiences fear), then the child simply gets their fear reinforced, rather than gaining the ability to *understand* that she is feeling fear. In a study of how mothers behave after their infants received an injection, Fonagy et al. (1995) observed that the mothers who most effectively soothed their child reflected their child's emotions, but also included other emotional displays in their mirroring, such as smiling or questioning. The mother's complex representation of the child's experience ensured that the child recognized it as related to, but not identical to, his own emotion. This serves to alter the child's negative emotions by helping him to implicitly build coping responses into the experience (Fonagy & Target, 1997). Therefore, in the early stages of life, these face-to-face exchanges of emotional signals help the child's brain learn how to understand and deal with emotions (Beebe et al., 1997).

Psychosocial Development

Listen to the Audio

In the previous section, we saw the powerful effect that attachment can have on a child's behaviour. Importantly, we also saw that attachment-related behaviours that are observed in infants and young children can sometimes predict how those individuals will behave as adults. This shows us that our development is actually a life-long process rather than a series of isolated stages.

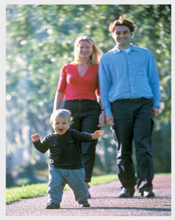
A pioneer in the study of *development across the lifespan* was Erik Erikson, a German-American psychologist. He proposed a theory of development consisting of overlapping stages that extend from infancy to old age (Erikson, 1982) (Table 10.4). In this module, we will examine the stages of development that relate to infancy and childhood. We will return to Erikson's work again in Modules 10.3 (Adolescence) and 10.4 (Adulthood), each time discussing the parts of his theory that apply to those stages of development.

Table 10.4 Erikson's Stages of Psychosocial Development

Table 10.4 Erikson's Stages of Psychosocial Development

Infancy: trust vs. mistrust: Developing a sense of trust and security toward caregivers.

ClickPop/Shutterstock



Toddlerhood: autonomy vs. shame and doubt: Seeking independence and gaining self-sufficiency.

Picture Partners/Alamy Stock Photo

Preschool/early childhood: initiative vs. guilt: Active exploration of the environment and taking personal initiative.

Monkey Business Images/Shutterstock

Childhood: industry vs. inferiority: Striving to master tasks and challenges of childhood, particularly those faced in school. Child begins pursuing unique interests.

keith morris/Alamy Stock Photo

Adolescence: identity vs. role confusion: Achieving a sense of self and future direction.

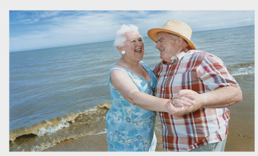
Tracy Whiteside dr/Shutterstock

Young adulthood: intimacy vs. isolation: Developing the ability to initiate and maintain intimate relationships.

OLJ Studio/Shutterstock

Adulthood: generativity vs. stagnation: The focus is on satisfying personal and family needs, as well as contributing to society.

Belinda Pretorius/Shutterstock



Aging: ego integrity vs. despair: Coping with the prospect of death while looking back on life with a sense of contentment and integrity for accomplishments.

Digital Vision/Photodisc/Getty Images

Development across the Lifespan

Listen to the Audio

Erikson's theory of development across the lifespan included elements of both cognitive and social development, and centred around the notion that at different ages, people face particular developmental *crises*, or *challenges*, based on emotional needs that are most relevant to them at that stage of life. If people are able to successfully rise to the challenge and get their emotional needs met, then they develop in a healthy way. But if this process is disrupted for some reason and people are not able to successfully navigate a stage, the rest of the person's personality and development could be impacted by certain deficits in their psychosocial functioning.

The first stage, *Infancy*, focuses on the issue of *trust vs. mistrust*. The infant's key challenge in life is developing a basic sense of security, of feeling comfortable (or at least not terrified) in a strange and often indifferent world. Infants just want to know that everything is okay, and this starts with being held—being physically connected through touch and affectionate contact. As the infant develops more complex social relationships, their basic emotional security (or insecurity) grows out of the trust vs. mistrust that develops out of this stage.

The second stage, *Toddlerhood*, focuses on the challenge of *autonomy vs. shame*. The toddler, able to move themselves about increasingly independently, is poised to discover a whole new world. The toddler discovers that they are a separate creature from others and from the

environment; thus, exploring their feelings of *autonomy*—exercising their will as an individual in the world—becomes very important. (If you've ever hung out with a toddler for extended periods of time, you have probably experienced their stubborn resistance, like emphatically stating "No!" to whatever you have suggested, for no clear reason.)

By the end of the first two stages, the person is, ideally, secure, and they feel a basic sense of themselves as having separate needs from others. On the other hand, if these stages were not successfully navigated, the person may struggle with feelings of inadequacy or low self-worth, and these will play out in their subsequent development.

The third stage, *Early childhood*, is characterized as the challenge of *initiative vs. guilt*. Building on the emotional security and sense of self-assurance that comes from the first two stages, here the growing child learns to take responsibility for themself while feeling like they have the ability to influence parts of their physical and social world. These preschoolyears involve children pushing their boundaries and experimenting with what they can do with their rapidly developing bodies, and then experiencing guilt when they are scolded or otherwise encounter the disapproval of others, such as their parents. If this stage is navigated successfully, the child develops increased confidence and a sense of personal control and responsibility.

The fourth stage, *Childhood*, is all about *industry vs. inferiority*. Here the child is focused on the tasks of life, particularly school and the various skill development activities that take place for that big chunk of childhood. This stage is an important part of the child's increasing feeling of being in control of their actions, leading them to be able to regulate themself to achieve long-term goals, develop productive habits, and gain a sense of themself as actively engaged in their own life.

Taking Erikson's first four stages together, you can see how childhood links emotional development with the feeling of being a competent individual. You can also see how the challenges associated with these stages are tied together with the quality of a person's key relationships and the many complex ways in which others (e.g., parents) help or hinder the child's ability to meet their emotional needs.

Module 10.2 Summary

Listen to the Audio

10.2a Know . . . the key terminology associated with infancy and childhood.

Review Module 10.2

Start Over Swap

0/24 REVIEWED · 0 MASTERED

accommodation

Previous Next Got It!

10.2b Understand . . . the cognitive changes that occur during infancy and childhood.

According to Piaget's theory of cognitive development, infants mature through childhood via orderly transitions across the sensorimotor,

preoperational, concrete operational, and formal operational stages. This progression reflects a general transition from engaging in the world through purely concrete, sensory experiences, to an increasing ability to hold and manipulate abstract representations in one's mind.

Review Applying Piaget's Theory

Study the table, then Check Your Understanding when you're ready.

	Stage
Bridgette's understanding of her world is largely based on her direct interactions with objects, which includes mouthing, grasping, and handling them. Which stage of Piaget's cognitive development is she most likely in? What is a major cognitive milestone that occurs during this stage?	sensorimotor
Jared is able to add and subtract as long as he is able to use actual objects in computing the problems. According to Piaget, Jared is probably in which stage of cognitive development?	concrete operational
Ranjit and his brother receive $1 for allowance. One week, his father mysteriously gave 100 pennies to his brother, but "only" 10 dimes to Ranjit. Ranjit's frustration with this situation is likely due to his being in which stage of cognitive development? Although he understands that money has value, Ranjit lacks conservation and so is most likely in which stage of cognitive development?	preoperational
A teacher wants to ask her students to describe what the United States would be like if the country were still run by England. According to Piaget, which stage of cognitive development would the students need to have reached to offer thoughtful answers to this scenario?	formal operational

Check Your Understanding

10.2c Understand . . . the importance of attachment and the different styles of attachment.

In developmental psychology, attachment refers to the enduring social bond between child and caregiver. Based on the quality of this bond, which is dependent upon appropriately responsive parenting, individuals develop an attachment style, which is their internalized feeling of security and self-worth. Children are either securely or insecurely attached, and insecure attachments can be further divided into disorganized, anxious/ambivalent, and avoidant styles.

10.2d Apply . . . the concept of scaffolding and the zone of proximal development to understand how to best promote learning.

According to Vygotsky, cognitive development unfolds in a social context. Adults who are attuned to the child's experience can help to scaffold the child's learning, guiding them such that they focus on challenges that lie on the very edge of their capabilities. This keeps a child fully engaged in the zone of proximal development, maximizing their skill development.

10.2e Analyze . . . how to effectively discipline children in order to promote moral behaviour.

Internalizing prosocial motives comes from children developing a secure attachment, experiencing empathy, and receiving inductive discipline. Children have an innate sense of morality, but this can be interfered with if their attachment needs are insufficiently met. Therefore, responsive parenting that helps the child feel secure lays the foundation for the child to become less self-focused. As the child cognitively develops and can more explicitly take others' perspectives, inductive reasoning that emphasizes perspective taking and empathy builds the habit of "doing good" because the child genuinely cares, rather than because the child wants to receive approval or to avoid punishment.

Module 10.3 Adolescence

Listen to the Audio

Picture Partners/Alamy Stock Photo

Learning Objectives

10.3a Know . . . the key terminology concerning adolescent development.

10.3b Understand . . . the process of identity formation during adolescence.

10.3c Understand . . . the importance of relationships in adolescence.

10.3d Understand . . . the functions of moral emotions.

10.3e Apply . . . your understanding of the categories of moral reasoning.

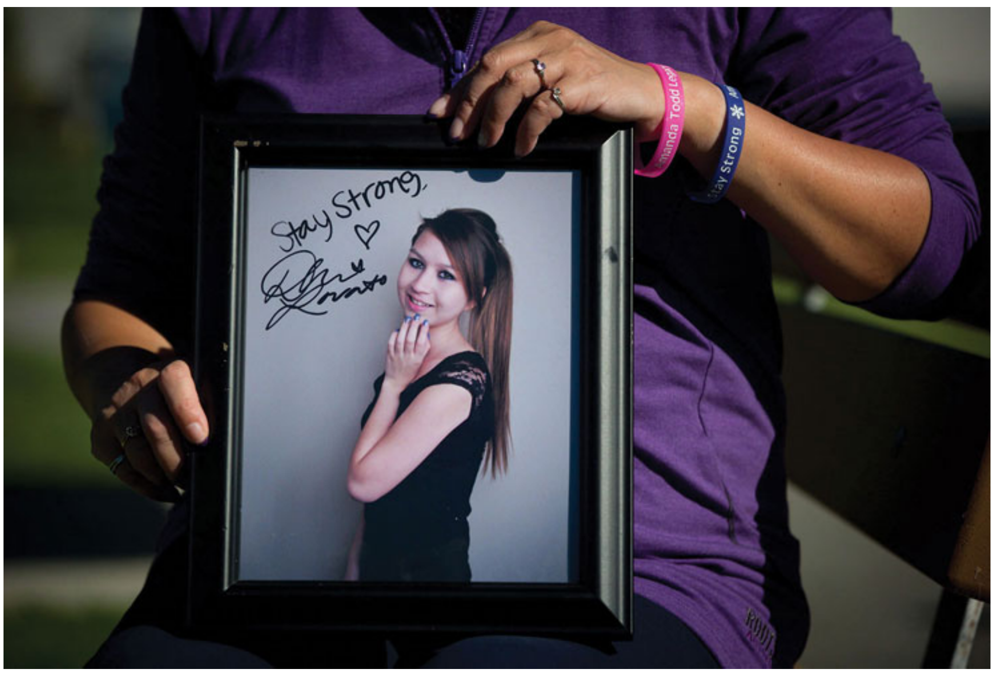
10.3f Analyze . . . the relationship between brain development and adolescent judgment and risk taking.

Teenagers are acutely aware of their self-image, and can go to great lengths to create an image they believe others will find likeable, interesting, and "popular." To make things even more challenging, teens not only contend with their in-person image, but also their "digital image." Therein lies its potential hazards. How people present themselves and interact with others may be less genuine than how they relate in person. The digital world offers a medium for creating an idealized version of the self, which may compromise self-acceptance, and leaves individuals vulnerable to cruel acts. Social media can be a platform for bullying and public humiliation, now that your indiscretions or mistakes can be posted online to haunt people for years to come. In 2012, 15-year-old Amanda Todd from British Columbia was ostracized and humiliated by her peers after revealing photos of her were posted online. Although she switched schools, she couldn't escape the online bullying, and tragically she died by suicide.

The internet and social media have revolutionized society in a single human generation. But we don't know how it will affect human development, particularly in the challenging period of adolescence when people are forming their identities and often committing some of

> *their biggest mistakes. This will undoubtedly be a major focus for research, and will raise major questions for society in the years to come.*

"It was the best of times; it was the worst of times." For many people, this pretty much sums up adolescence, a time of confusion, pimples, and existential angst, as well as hanging out with friends, gaining greater independence from parents, and focusing intensely on intimate relationships. This often tumultuous time between childhood and adulthood involves many physical changes, increasing cognitive sophistication, and a great deal of emotional and social volatility.



Amanda Todd: A tragic case of cyber-bullying.

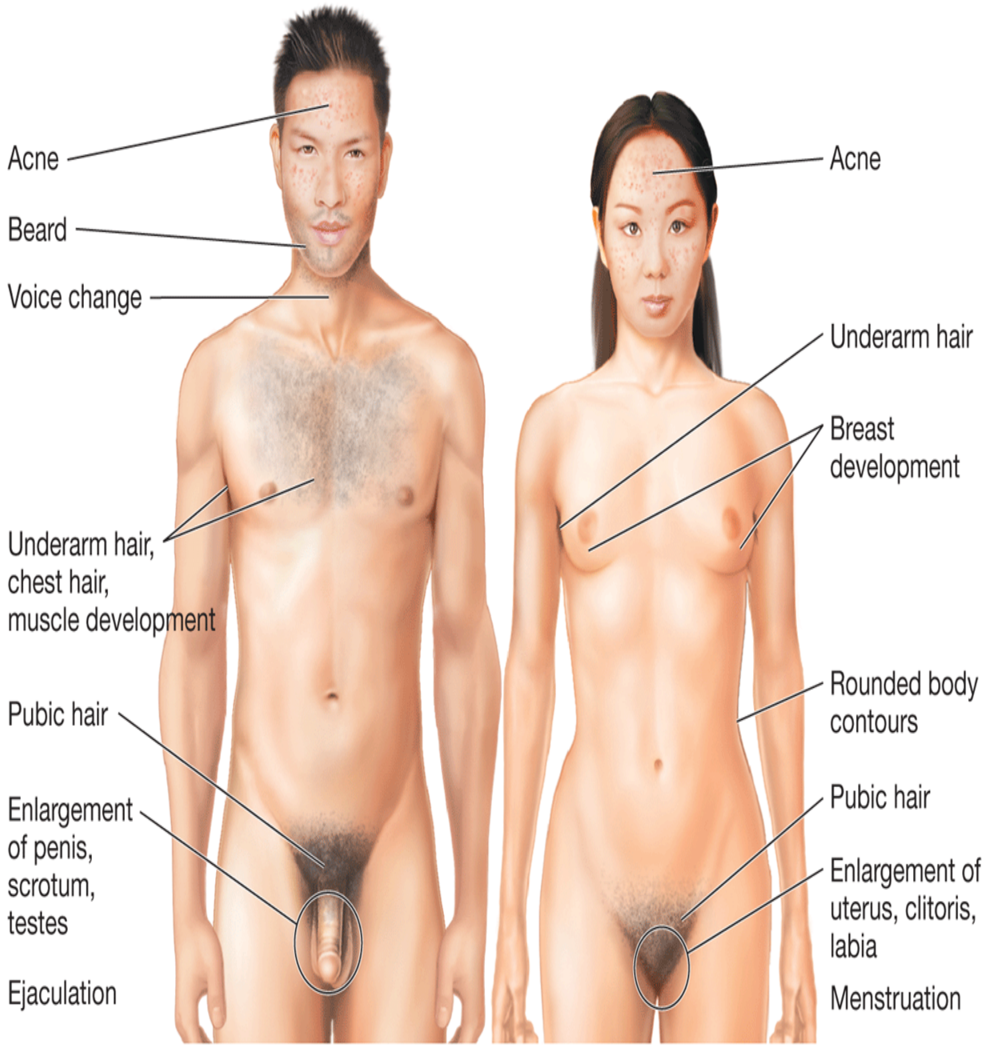
Darryl Dyck/Canadian Press

Physical and Emotional Changes in Adolescence

Listen to the Audio

The physical transition from childhood to adolescence starts with puberty, culminating in reproductive maturity. Puberty begins at approximately age 11 in girls and age 13 in boys, although there is wide variation. The changes that occur during puberty are primarily caused by hormonal activity. Physical growth is stimulated by the pituitary gland, under the control of the *hypothalamus*, which regulates the release of hormones such as testosterone and estrogen. These hormones also contribute to the development of *primary and secondary sex traits* in boys and girls. **Primary sex traits** are *changes in the body that are part of reproduction* (e.g., enlargement of the genitals, ability to ejaculate, the onset of menstruation). **Secondary sex traits** are *changes in the body that are not part of reproduction*, such as the growth of pubic hair, increased breast size in females, and increased muscle mass in males (Figure 10.14).

Figure 10.14 Physical Changes That Accompany Puberty in Male and Female Adolescents



Hormonal changes accelerate the development of physical traits in males and females. Changes involve maturation of the reproductive system (primary sex traits) as well as secondary sex traits such as enlargement of breasts in women and increased muscle mass in males.

Source: Lilienfeld, S. O., Lynn, S. J., Namy, L. L., & Woolf, N. J. (2011). *Psychology: From Inquiry to Understanding*, 2nd ed., © 2011. Reprinted and electronically reproduced by permission of Pearson Education, Inc., New York, NY.

For girls, **menarche**—*the onset of menstruation*—typically occurs around age 12. The timing of menarche is influenced by physiological and environmental factors, such as nutrition, genetics, physical activity levels, illness (Ellis & Garber, 2000), and family structure, such as the absence of

a father (Bogaert, 2008). Boys are considered to reach sexual maturity at **spermarche**, *their first ejaculation of sperm*, at around age 14.

Interestingly, puberty happens much earlier now than it did 100 years ago. American teens in the 19th century started puberty at age 16 to 17 on average; nowadays, about one-third of boys show the beginnings of physical maturation at age 9 (Reiter & Lee, 2001), as do almost 40% of European-American girls, and almost 80% of African-American girls (Herman-Giddens et al., 1997). This is probably because of behavioural changes that increase body fat (e.g., poor nutrition, insufficient exercise), and environmental stresses that increase stress hormones in the body. As the environment changes, our biology changes along with it.

Teens′ rapidly developing bodies bring a host of developmental challenges, from feelings of self-consciousness and a heightened desire to be attractive and to fit in, to increasing sexual interest and experimentation, to the negative moods that accompany hormonal fluctuations (Warren & Brooks-Gunn, 1989). Adolescents who begin to physically develop earlier than their peers can face additional challenges. Early-developing females often have to cope with being teased and having their bodies made into objects of others′ attention. Early-developing boys tend to have it easier; their masculine traits are often regarded positively by both themselves and their peers. Nevertheless, early developers of either gender run a greater risk of drug and alcohol abuse and of unwanted pregnancies.

Research has shown that adolescence is a time of major brain changes as well. In particular, the frontal lobes undergo a massive increase in myelination, speeding up neural firing by up to 100-fold in those areas (Barnea-Goraly et al., 2005; Sowell et al., 2003). The frontal lobes also undergo a wave of synaptic pruning, during which relatively unused synaptic connections are broken, leaving a more efficiently functioning

brain. The net result of these changes is an increase in teens' abilities to exert self-control. However, during adolescence this process is merely under way, not completed, leaving teens often struggling with volatile emotional experiences.

The physical and emotional changes associated with puberty are widely believed to be connected to each other. For example, mood swings and experimental high-risk behaviours are attributed to "raging hormones." But is this characterization of adolescence accurate? Are most teens hormonally supercharged animals, constantly desiring to hook up with the first attractive (or even unattractive) person to cross their path?

The belief that adolescence is tumultuous has held sway in popular culture as well as in psychology since at least the early 1900s (Hall, 1904); some theorists even believed that the absence of extreme volatility was an indication of arrested development (Freud, 1958). However, this belief came under fire from cultural anthropologists (Benedict, 1938; Mead, 1928), who discovered that in many non-Western cultures, the transition from childhood to adulthood happened remarkably smoothly; children simply began to take on more and more responsibilities, and then moved into their adult roles without such a dramatic and volatile transition.

In the decades since, research has painted a somewhat mixed picture of adolescence. On the up side, the majority of teens keep their forays into debauchery fairly minimal and do not let their larger lives get unduly harmed by their experimentation. Most teens also grow out of these patterns fairly readily and move into adulthood relatively unscathed by their teenage experiences (Bachman et al., 1997). Navigating adolescence successfully leaves teens feeling they know who they are, having constructed a healthy social identity, and having learned to identify at least some of their own personal values and goals. On the down side, however, the emotional road through adolescence also contains its fair

share of bumps. Teens are prone to experiencing particularly intense and volatile emotions (Dahl, 2001; Rosenblum & Lewis, 2003), including heightened feelings of anxiety and depression (Van Oort et al., 2009).

Emotional Regulation during Adolescence

Listen to the Audio

Adolescence is a time when the capacity to regulate emotions is still a work in progress (McLaughlin et al., 2011). Research at Queen's University has shown that one key to adolescents effectively regulating their emotions is to be able to draw flexibly upon a diverse set of self-control strategies. Adolescents who rely upon a limited number of adaptive strategies (e.g., learning to suppress emotions or, conversely, learning to always reach out and talk to people about their feelings) and narrowly rely upon their chosen strategies are at greater risk for developing symptoms of anxiety and depression (Lougheed & Hollenstein, 2012).

One of the most flexible and powerful strategies for dealing with emotions is cognitive reframing (see Module 16.2), where we learn to look at our experience through a different "frame." For example, failure can be reframed as an opportunity to learn, and a threatening experience as a challenge to be overcome. The ability to effectively choose reframing strategies, especially when under the grip of strong emotions, relies upon a sophisticated cognitive control network involving the frontal and parietal lobes (McClure et al., 2004). These are precisely the brain areas that are undergoing the most development during adolescence. Thus, helping adolescents learn self-control strategies is critically important, not only for developing good habits, but also for helping them to develop the cognitive control systems in their brains. The ability to reframe is critical to one of the most important skills adolescents need to hone as they

move into adulthood—the ability to **delay gratification**, *putting off immediate temptations in order to focus on longer-term goals*. For example, should you party with your friends or study for the test next week? Adolescents who master this skill are far more likely to be successful in life. An inability to delay gratification reflects a tendency to discount the future in order to live in the moment, which lies at the heart of a wide range of dysfunctional behaviours, ranging from addictions and unsafe sex, to racking up credit card debt and failing to meet deadlines (Romer et al., 2010).

Importantly, delaying gratification is a skill that people can learn. In fact, the challenge of delaying gratification is basically the same as the challenge of controlling emotions, and the same strategies, such as cognitive reframing, are useful.

Working the Scientific Literacy Model

Adolescent Risk and Decision Making

Listen to the Audio

One of the nightmares of many parents is the smorgasbord of disasters that they assume awaits adolescents as they explore their increasing independence—sexually transmitted diseases, drugs, and the whole host of alluring activities parents wish were never invented (despite their own fond memories of their younger years . . .).

What do we know about adolescence and risky decision making?

Parents do have some reason to fear; research shows that adolescents are particularly prone to behaving impulsively and making risky decisions (Chambers et al., 2003; Steinberg, 2007). As a result, driving recklessly, unsafe sex (Arnett, 1992), drug and alcohol abuse, accidents, and violence are more common during adolescence than during any other stage of life (Chambers & Potenza, 2003; Steinberg, 2008).

Why might many adolescents make poor judgment calls in comparison to children or adults? Adolescence, at least as we may see it expressed in North America, is a perfect storm of risk-inducing factors, including a teenage culture that glorifies high-risk activities, intense peer pressure, increased freedom from parents, a growing ability to critically question the values and

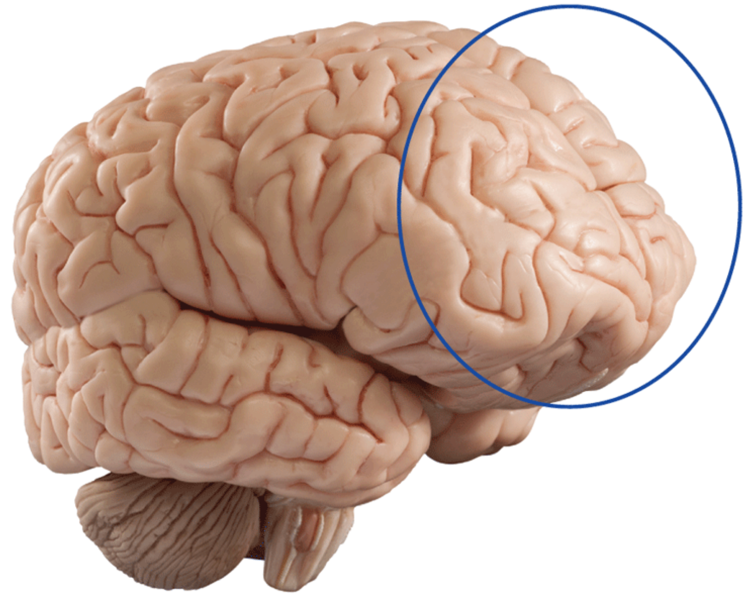
traditions of society, and a brain that is ripe for risk due to still-developing cognitive control systems (especially the prefrontal cortex) and well-developed reward systems located in limbic areas (Casey et al., 2008; Galvan et al., 2006). Indeed, one view of many developmental scientists is that teenage neurophysiology is a battleground of opposing urges; the reward system acts like the proverbial devil on the shoulder, urging, "Do it! Do it!" while the underdeveloped prefrontal areas play the role of the beleaguered angel, pleading, "Don't do it! It's not worth it!"

How can science test the link between brain function and decision making in adolescents?

Modern technology has enabled researchers to look at the brain activity of adolescents in the process of making risky decisions. In one study, adolescents had their brains scanned using functional magnetic resonance imaging while they played a betting game. In this experiment, participants had to make a decision between a high-risk, high-reward choice (placing a $6 bet with a 25% chance of winning) and a low-risk, low-reward choice (placing a $1 bet with a 50% chance of winning).

Adolescents who selected the high-risk choice had less brain activity in their prefrontal cortex than those who selected the low-risk choice (Figure 10.15; Shad et al., 2011). It seems that choosing the high-risk gamble was, in a sense, easier; those teens simply focused on how much they wanted the bigger reward, and ignored the higher likelihood that they would lose. On the other hand, making the low-risk choice involved some neurological conflict; those teens wanted the bigger reward, but restrained themselves by taking into account the probabilities. This restraint involved the frontal lobes.

Figure 10.15 Extended Brain Development



The prefrontal cortex (circled in blue) continues to develop through adolescence and into young adulthood.

werbefoto-burger.ch/Fotolia

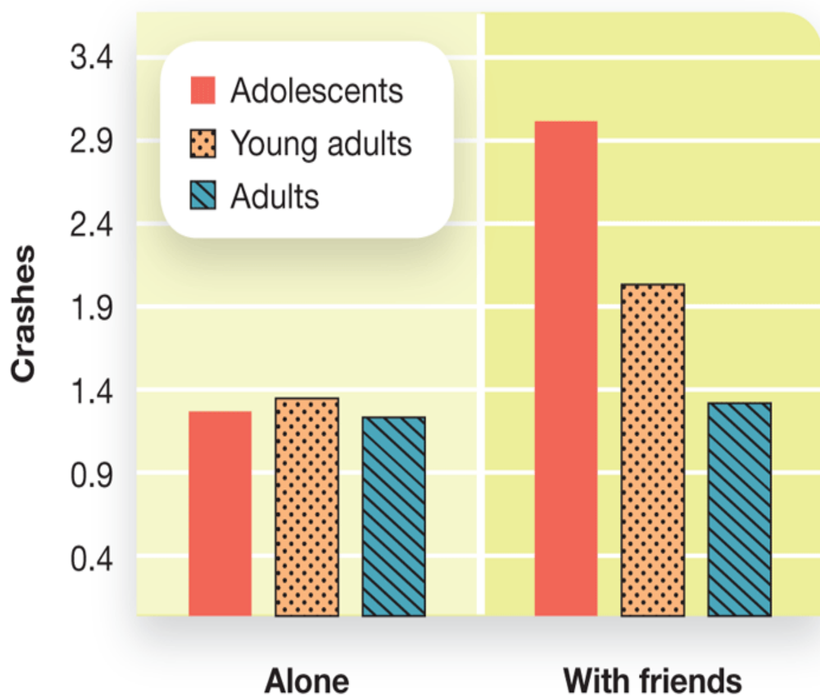
This study helps to shed light on adolescent decision making in general. Compared to adults, adolescents have less-developed frontal lobes, and in *some* situations are more likely to default to their strong reward impulses, rather than restraining their desires as a result of more sober and complex calculations of what would be in their best interest overall.

Can we critically evaluate this explanation for risky decision making?

This brain-based explanation does not fully *explain* adolescents' behaviour, in at least two important ways. First, in this particular study, it's not clear whether the prefrontal activation reflects teens thinking in more complex ways, or whether it shows that they are consciously restraining themselves from following their reward-focused desires. Is the key factor here about complex thought or self-control?

Second, in everyday decisions, other factors likely influence teens' preference for risk, such as the size of rewards and costs, the importance of long-term goals, personality characteristics such as extraversion (which is related to reward sensitivity), and the social context in which the decisions occur. Attributing risky behaviour in adolescents to underdeveloped frontal lobes is a gross simplification of the issue, and ignores nuanced scientific studies that examine these and other factors (Blakemore, 2018; Romer et al., 2017). For example, psychologists have found that in some situations, adolescents are no more likely to engage in risky behaviour than adults. But when other teens are around, this propensity changes (see Figure 10.16). In fact, the presence of other teens can reduce the activity in the frontal lobes (Segalowitz et al., 2012). Clearly, realistic strategies for reducing adolescent risk taking should also consider the important role that situational factors play in adolescents' decision making.

Figure 10.16 What Drives Teenagers to Take Risks?



One key factor in risk taking is simply *other teenagers*. When teens play a driving video game with other teens, they crash more than when playing the same game alone, and more than adults playing the game (from Steinberg, 2007).

Source: Adapted from Figure 2, p. 630 in Gardner, M., & Steinberg, L. (2005). Peer influence on risk-taking, risk preference, and risky decision-making in adolescence and adulthood: An experimental study. *Developmental Psychology*, *41*(4), 652–635.

Why is this relevant?

Risk taking peaks during adolescence, and risk-related behaviours such as reckless driving account for a high proportion of injuries and deaths in this group. This is cause for significant concern and should be considered, in a scientifically informed way, within programs and institutions that involve adolescents (e.g., school systems). Popular media such as films and books may give us the sense that the period of adolescence represents a public health crisis. It is important to keep in mind that although risk taking rises in adolescence, its overall prevalence (e.g., the actual percentage of adolescents who engage in risky behaviour) is low. In other words, you should not base your view of adolescents on only a handful of individuals who confirm your expectations (i.e., who fit this stereotype).

Cognitive Development: Moral Reasoning vs. Emotions

Listen to the Audio

As we have just seen, making wise decisions involves activation of the prefrontal cortex. This area is involved in higher cognitive abilities, such as abstract reasoning and logic (what Piaget referred to as *formal operational* thinking; see Module 10.2), which also begin to show substantial improvements starting at about age 12. Since Piaget, psychologists have generally believed that the shift to formal operational thinking laid the foundation for effective moral reasoning. For adolescents, this increase in complex cognitive ability allows them to consider abstract moral principles, to view problems from multiple perspectives, and to think more flexibly.

Kohlberg's Moral Development: Learning Right from Wrong

Listen to the Audio

The most influential theory of the development of moral reasoning was created by Lawrence Kohlberg, after studying how people reasoned through complex moral dilemmas. Imagine the following classic scenario, unlikely as it may be:

> A trolley is hurtling down the tracks toward a group of five unsuspecting people. You are standing next to a lever that, if pulled, would direct the trolley onto another track, thereby saving the five individuals. However, on the second track stands a single, unsuspecting person, who would be struck by the diverted trolley.

What would you choose to do? Would you pull the lever, directly causing one person to die, but saving five others? Or would you be unwilling to directly cause someone's death and therefore do nothing? Moral dilemmas provide interesting tests of reasoning because they place values in conflict with each other. Obviously, five lives are more than one, yet most people are also unwilling to take a direct action that would cause a person to be killed.

But even more important than *what* you would choose is *why* you would choose it. Kohlberg (1984) believed that people's reasons evolved as they grew up and became better able to think in complex ways. By analyzing people's reasons for their decisions in these sorts of dilemmas, he developed a stage theory of moral development, here organized into three general stages (see Table 10.5).

Table 10.5 Applying Kohlberg's Stages of Moral Reasoning

Match each of the three stages of moral reasoning to the corresponding description and example as applied to the trolley dilemma.

Stage of Moral Development	Description	Application to Trolley Dilemma
	Characterized by self-interest in seeking reward or avoiding punishment. Considered a very basic and egocentric form of moral reasoning.	"I would not flip the trolley track switch because I would get in trouble."
	Regards social conventions and rules as guides for appropriate moral behaviour. Directives from parents, teachers, and the law are used as guidelines for moral behaviour.	"I would not flip the switch. It is illegal to kill, and if I willfully intervened I would probably violate the law."
	Considers rules and laws as relative. Right and wrong are determined by more abstract principles of justice and rights.	"I would flip the switch. The value of five lives exceeds that of one, so saving them is the right thing to do even if it means I am killing one person who would otherwise not have died."

Start Over

At the preconventional level, people reason largely based on self-interest, such as avoiding punishment. This reasoning is what parents predominantly appeal to when they threaten children with some form of punishment for their behaviour. At the conventional level, people reason largely based on social conventions (e.g., tradition) and the dictates of authority figures; this is what parents are appealing to with the famously frustrating "Because I said so!" At the postconventional level, people reason based on abstract principles such as justice and fairness, thus enabling them to critically question and examine social conventions, and to consider complex situations in which different values may conflict.

Kohlberg regarded the three stages of moral reasoning as universal to all humans; however, because he developed his theory mostly through the study of how *males* reason about moral dilemmas, other researchers argued that he had failed to consider that females may reason about moral issues differently. Carol Gilligan (1982) suggested that females base

moral decisions on a standard of *caring for others*, rather than the "masculine" focus on standards of justice and fairness that Kohlberg emphasized. Some support has been found for this; women are more likely to highlight the importance of maintaining harmony in their relationships with others (Lyons, 1983). On the other hand, men and women generally make highly similar judgments about moral dilemmas (Boldizar et al., 1989), and both genders make use of both caring and justice principles (Clopton & Sorell, 1993). These findings have led other researchers to question the importance of the gender distinction (Jaffee & Hyde, 2000).

However, a potentially more devastating critique has been made against the moral reasoning perspective in general, based on research showing that moral reasoning doesn't actually predict behaviour very well (Carpendale, 2000; Haidt, 2001). *Knowing* that something is right or wrong is very different from *feeling* that it is right or wrong. According to Jonathan Haidt's *social intuitionist model* of morality, in our everyday lives our moral decisions are largely based on how we feel, not what we think. Haidt argues that moral judgments are guided by intuitive, emotional reactions, like our "gut feelings," and then afterward, we construct arguments to support our judgments. For example, imagine the following scenario (adapted from Haidt, 2001):

> Julie and Steven are brother and sister. They are travelling together in France on summer vacation from college. One night they are staying alone in a cabin near the beach. They decide that it would be interesting and fun if they shared a "romantic" evening together. At the very least it would be a new experience for each of them. They both enjoy the experience but they decide not to do it again. They keep that night as a special secret, which makes them feel even closer to each other.

Emotion is a major component of moral thinking and decision making.

Alex Wong/Getty Images

How do you react to this scenario? Was what took place between the two siblings morally acceptable? If you are like most people, you probably did *not* think carefully through this scenario, consider different perspectives, and examine your reasoning before making a decision. Instead, your decision was made immediately, and was guided by your gut reaction, rather than rational deliberation. It is only after making a decision that most people engage in more thoughtful and reflective reasoning, trying to justify their decision. So emotions play a key role in our moral regard for others. Even chimpanzees seem to feel this way. When children and chimpanzees were wronged by another person, both species expended physical effort (chimps) or monetary units (children) if it meant that they could watch the antisocial instigator be punished (Mendes et al., 2017).

Improvements in emotional regulation that occur during adolescence have an influence on moral behaviour. Without some control over emotional reactions, people can become overwhelmed by the personal

distress they experience upon encountering the suffering of others (Eisenberg, 2000), and end up attending to their own needs rather than others'. Self-control, in turn, involves brain areas that are rapidly developing in adolescents, particularly the prefrontal cortex.

It is interesting to consider that the development of key moral emotions, such as empathy, is intimately bound up with the extent to which a person's social relationships have been healthy right from birth (see Module 10.2). People who are regularly socially included and treated well by others are more likely to develop trust and security, which results in well-developed areas of the prefrontal cortex necessary for good decision making and well-developed moral emotional systems. This shows us that the early roots of moral behaviour reach all the way back into infancy, when attachment styles are initially formed, and extend into adolescence and beyond, when complex cognitive and self-control abilities are strengthened.

Social Development: Identity and Relationships

Listen to the Audio

The final aspect of adolescence to consider is the role of social relationships. To teenagers, friends are everything—the people who will support your story to your parents about why you came home late, who laugh hysterically with you at three in the morning, and who help you feel that your choice of clothing is actually cool. Friends are central to two of the most important changes that occur during adolescence—the formation of a personal identity, and the shift away from family relationships and toward peer and romantic relationships. These major changes in teens' lives are sources of growth and maturation, but are also often sources of distress and conflict.

Who Am I? Identity Formation during Adolescence

Listen to the Audio

A major issue faced by adolescents is forming an **identity**, which is *a clear sense of what kind of person you are, what types of people you belong with, and what roles you should play in society*. It involves coming to appreciate and express one's attitudes and values (Arnett, 2000; Lefkowitz, 2005), which are, in large part, realized through identifying more closely with peers and being accepted into valued social groups.

You may recall Erikson's theory of psychosocial development from Module 10.2 (see Table 10.4, in Module 10.4 , for an overview). Erikson described the stage of *adolescence* as involving the struggle of *identity vs. role confusion*. Adolescents are seeking to define who they are, in large part through their attachment to specific social groups; doing this stage successfully allows them to enter adulthood with a sense of their own authenticity and self-awareness.

In fact, forming an identity is so important in the teenage years that adolescents may actually experience numerous *identity crises* before they reach young adulthood. An identity crisis involves curiosity, questioning, and exploration of different identities. It can also involve attaching yourself to different goals and values, different styles of music and fashion, and different subcultural groups, all the while wondering where you best fit in, and who you really are.

The process of exploring a variety of identities, and experiencing more independence from the family, sets the stage for potential conflict, particularly with parents. Even well-meaning parents may feel somewhat threatened as their teenage son or daughter starts to establish more distance or starts to experiment with identities they feel are unwise. They may feel hurt and want to hold on to their closeness with their child. They may also feel concerned and want to protect their child from making mistakes they will later regret. So, parents may simply be trying to help, but their advice, rules, or insistence that the teen abandon certain goals ("There's no way you're giving up math and science to take drama and music!") may be interpreted as being restrictive or controlling. This, not surprisingly, can lead to conflict. And the more conflict teens perceive at home, the more they may turn to peers.

Peer Groups

Listen to the Audio

Friendships are a major priority for most adolescents. Friendships generally take place within a broader social context of small groups or *cliques*, and the membership and intensity of friendships within a clique constantly change (Cairns & Cairns, 1994). Adolescent *crowds*—often identified with specific labels, such as "jocks," "geeks," "Goths," or "druggies"—are larger than cliques and are characterized by common social and behavioural conventions.

Adolescents who can't find their place in social networks have a difficult time; social exclusion can be a devastating experience. When rejected by peers, some adolescents turn to virtual social networks for online friendships, or join distinctive sub-groups in order to gain acceptance. This tendency to seek acceptance within specific groups is obviously not limited to teenagers, but adolescence is a time of particular social vulnerability because adolescents are, in general, so actively working on their "identity project."

Photos 12/Alamy Stock Photo

AF archive/Alamy Stock Photo

For decades, television shows and movies have offered glimpses into life within adolescent cliques and crowds. The portrayals may be exaggerated, but they are often successful because viewers can closely identify with the characters' experiences.

One of the most troubling outcomes of social rejection is the experience of shame, which is a feeling that there is something wrong with you. It can be accompanied by feelings of worthlessness, inferiority, or just a more subtle, gnawing feeling that there is something wrong with you, that you need to prove yourself, and that you aren't quite good enough. Shame-prone individuals have often experienced substantial social rejection; a key source is within the family, such as when a child's attachment needs are consistently unmet.

Many psychologists believe that shame and other negative emotions that are connected to social rejection, bullying, teasing, and being publicly humiliated can lead to tragic outbursts of violence, such as the school shootings that have become disturbingly frequent in the United States in recent years. Just as the *security* from having your need to belong satisfied leads to the development of empathy and moral behaviours (see Module 10.2), the *insecurity* from having your need to belong go unmet can lead to violence.

Romantic Relationships

Listen to the Audio

As children mature into teenagers, their attachment needs shift into their intimate or romantic relationships. Here, the dramas of their interpersonal systems play out on a new stage. In other words, teenagers are pretty interested in being attracted to each other. This shift opens up the potential exploration of new worlds of emotional and physical intimacy and intensity.

Many people, for many different reasons, may feel uncomfortable with adolescents exploring and engaging in sexual behaviour. Perhaps unsurprisingly, North American teenagers themselves don't seem to agree. Between 40% and 50% of Canadian teens aged 15 to 19 report having had sexual intercourse (Boyce et al., 2006; Rotermann, 2008), and the proportion who have engaged in other forms of sexual acts such as oral sex is considerably higher. More than 80% of American adolescents report engaging in non-intercourse sex acts before the age of 16 (Bauserman & Davis, 1996), and more than half of Canadian teens in grade 11 report having experienced oral sex (Boyce et al., 2006). Some teens turn to oral sex because they see it as less risky than intercourse, both for their health and their social reputation (Halpern-Fisher et al., 2005).

Same-sex sexual encounters are also very common and typically occur by early adolescence (Savin-Williams & Cohen, 2004), although contrary to stereotypes, such an experience is not an indication of whether a person

identifies themselves as homosexual, or as having any other sexual orientation. The process by which adolescents come to recognize their sexual orientation depends on many factors, including how they are perceived by their family and peers. Because of some people's still-existing prejudices against non-heterosexual orientations, it is common for many people who don't identify as heterosexual to experience some difficulty accepting their sexuality, and thus, to struggle with feelings of rejection toward themselves. However, this process is not always difficult or traumatic; it largely depends on how supportive family and other relationships can be. Nevertheless, despite these extra identity challenges, homosexuals have about the same level of psychological well-being as heterosexuals (Rieger & Savin-Williams, 2012).

Although sexual exploration is a normal part of adolescence, it can unfortunately be dangerous for many people. Research at the University of New Brunswick has shown that among Canadian teens in grade 11, approximately 60% of both males and females reported having experienced psychological aggression against them by their romantic relationship partner. About 40% experienced sexual aggression, generally in the form of being coerced or pressured into having sex (Sears & Byers, 2010).

Overall, the emotional upheaval of relationships, from the ecstasy of attraction, to the heartbreak of being rejected or cheated on, to the loneliness a person may feel in the absence of relationships, consumes a great deal of many teenagers' attention and resources and is a central part of the often tumultuous experience of adolescence.

Module 10.3 Summary

Listen to the Audio

10.3a Know . . . the key terminology concerning adolescent development.

Review Module 10.3

Start Over Swap 0/9 REVIEWED · 0 MASTERED

menarche

Previous Next Got It!

10.3b Understand . . . the process of identity formation during adolescence.

A major challenge of adolescence is the formation of a personal identity, which involves exploring different values and behaviours, and seeking

inclusion in different social groups. The eventual outcome, if navigated successfully, is a relatively stable and personally satisfying sense of self.

10.3c Understand . . . the importance of relationships in adolescence.

Teenagers undergo a general shift in their social attachments as family becomes less central and friends and intimate relationships take on increased significance. The failure to establish a sense of belonging is an important precursor to dysfunctional behaviours and violence.

10.3d Understand . . . the functions of moral emotions.

Contrary to theories of moral reasoning, recent research on moral emotions suggests that these feelings are what lead to moral behaviour, and reasoning generally follows as a way of justifying the behaviour to oneself.

10.3e Apply . . . your understanding of the categories of moral reasoning.

Apply Activity

Read the following scenarios and identify which category of moral reasoning (preconventional, conventional, or postconventional) applies to each.

1. Jeff discovers that the security camera at his job is disabled. He decides it is okay to steal because there's no way he's going to get caught.
2. Margaret is aware that a classmate has been sending hostile text messages to various people at her school. Although she does not

receive these messages, and she does not personally know any of the victims, Margaret reports the offending individual to school officials.

10.3f Analyze . . . the relationship between brain development and adolescent judgment and risk taking.

Many problems with judgment and decision making involve a kind of tug-of-war between emotional reward systems in the limbic areas of the brain, and the prefrontal cortex, which is involved in planning, reasoning, emotion, and impulse control. Because the prefrontal cortex is still developing during adolescence, particularly through myelination and synaptic pruning, it is often not sufficient to override the allure of immediate temptations, leading to failures to delay gratification. These observations about adolescent brain development can put some, but not all, aspects of adolescent risk taking into biological context.

Module 10.4 Adulthood and Aging

Listen to the Audio

reppans/Alamy Stock Photo

Learning Objectives

- 10.4a Know . . . the key terminology concerning adulthood and aging.
- 10.4b Know . . . the key areas of growth experienced by emerging adults.
- 10.4c Understand . . . age-related disorders such as Alzheimer's disease.
- 10.4d Understand . . . how cognitive abilities change with age.
- 10.4e Apply . . . your attitudes about marriage.
- 10.4f Analyze . . . the stereotype that old age is a time of unhappiness.

"Use it or lose it." This is one of those sayings that you grow up hearing, and you think, "Yeah, whatever, I'm young and awesome; I'm never going to lose it." But time goes by, and like it or not, the day will come when you may find yourself puffing at the top of a flight of stairs, or standing in the kitchen wondering why you're there. You may wonder, what's happened to me? Why do I feel so old?

We all know that if you stay physically active, your body will stay stronger and healthier as you age, maintaining better cardiovascular fitness, muscle tone, balance, and bone density. Thankfully, recent advances in neuroscience confirm that the same thing is true for the brain. If you use it, you're less likely to lose it. This is important because, unfortunately, brain connections are exactly what people lose as they age, particularly from their 60s onward, resulting in less neural connectivity and reductions in grey and white matter volume. These neurological losses are accompanied by gradual declines in some types of cognitive functioning.

The fact that exercising your brain slows down the neural signs of aging—and even reduces the likelihood of developing age-related disorders such as Alzheimer's disease—is great news. And even better news is that

exercising your brain is actually fun! It's not like spending countless hours on the brain equivalent of a treadmill, memorizing pi to 35 decimal places. Instead, neurological exercisers are those who regularly stay actively involved in things they love—games, sports, social activities, hobbies, and in general remaining lifelong learners. This makes getting old sound not so bad after all. . . .

Becoming an adult does not entail crossing any specific line. It's not as clear-cut as adolescence; after all, puberty is kind of hard to miss. In Canada, from a legal perspective you are considered to be an adult at 18. Still, it's questionable whether 18-year-olds are fully fledged adults; they have essentially the same lifestyle as 17-year-olds, often at home or in student housing, with relatively few responsibilities beyond brushing their teeth and dragging themselves to work or school. As time goes by, people get increasingly integrated into working society, begin careers, usually establish long-term relationships, pay bills, possibly have children, and in a variety of ways conform to the expectations and responsibilities of adulthood. As they move slowly from adolescence toward retirement and beyond, adults go through a number of changes—physically, socially, emotionally, cognitively, and neurologically. This module will examine these changes across the stages of adult development.

From Adolescence through Middle Age

Listen to the Audio

When we are children and adolescents, we often feel like we can't wait to grow up. Many of you can likely remember how large and mature 18-year-olds seemed when you were younger. Eighteen-year-olds went to university, had jobs, and seemed so poised. Now that many of you are in this age range, you can see that this view of emerging adults is a bit naïve. That said, people in this age group have their entire adult lives in front of them. The adventure is just beginning.

Emerging Adults

Listen to the Audio

For young people living in industrialized countries, the time between adolescence and adulthood is a period of great personal challenge and potential growth. *Emerging adults* confront many adaptive challenges (Arnett, 2000): they may leave home for the first time; start college, university, or full-time work; become more financially responsible for themselves; commit to and cohabit with romantic partners; and, of course, deal with the endless crises of their friends.

Researchers at the University of Guelph conducted an in-depth study of the experiences of emerging adults, identifying three main areas of personal growth: relationships, new possibilities, and personal strengths (Gottlieb et al., 2007). Interestingly, these correspond perfectly to the domains of relatedness, autonomy, and competence that are widely viewed as key pillars of healthy development throughout the lifespan (these are discussed in depth in Module 11.3).

In the *relationships* domain, most people in this study felt that they had grown in their abilities to trust others, to recruit support from others, and generally to be able to establish strong and intimate connections. This increased intimacy is an outgrowth of people learning to be themselves with others, to know who they are, and to connect in ways that accept and encourage people's authenticity. The domain of *new possibilities* reflects the greater freedom that emerging adults enjoy to choose activities that better fit their goals and interests, to broaden their

horizons, and to actively search for what they want to do with their lives. The domain of *personal strength* reflects the confidence young adults gain as they confront more serious life challenges and discover that they can handle them.

The emergence into adulthood is a time, therefore, of immense opportunity. As a person comes into their own, they can engage with the world that much more confidently and effectively. And that seems to be the story of adulthood: greater opportunities, greater challenges.

Early and Middle Adulthood

Listen to the Audio

The first few decades of early adulthood are typically the healthiest and most vigorous times of life. People in their 20s to 40s are usually stronger, faster, and healthier than young children or older people. After adolescence, when you have finished growing, you enter a kind of plateau period of physical development in which the body changes quite slowly (aside from obvious exceptions, like pregnancy). For women, this period starts to shift at approximately age 50 with the onset of **menopause**, *the termination of the menstrual cycle and reproductive ability*. The physical changes associated with menopause, particularly the reduction in estrogen and progesterone, can result in symptoms such as hot flashes, sleep disruption, and changes in mood. Psychologically, some women experience a period of adjustment, perhaps feeling like they are no longer "young" or as potentially worthwhile; these types of adjustment problems are common to many different major life changes, and as always, the severity of such symptoms varies widely among individuals. Men, on the other hand, don't experience a physical change as substantial as menopause during middle adulthood, although testosterone production and sexual motivation typically decline.

Early and middle adulthood are also an important time for relationships, particularly of the romantic variety. This links back to Erik Erikson's theory of development across the lifespan (see Table 10.4). As mentioned in earlier modules, in each of Erikson's stages, the individual faces a specific developmental challenge, or crisis of development. If they

successfully resolve this crisis and overcome this challenge, the person becomes better able to rise to the challenges of subsequent stages and moves on in life, letting go of specific issues that characterized the earlier stages. However, if the stage is not successfully resolved, lingering issues can interfere with the person's subsequent development.

According to Erikson's theory, the first four stages of development are completed during infancy and childhood (see Module 10.2); the fifth stage takes place during adolescence (see Module 10.3). In the sixth stage, *Young adulthood*, the individual must cope with the conflict between *intimacy and isolation*. This stage places emphasis on establishing and maintaining close relationships. The following stage of *adulthood* involves the tension of *generativity vs. stagnation*, during which the person either becomes productively engaged in the world, playing somehow useful roles in the world, or else the person "stagnates," becoming overly absorbed with their own lives, and failing to give back to the world in a useful way.

Thus, putting these two stages together gives a decent picture of much of the central foci in an adult's life. Adulthood is this challenge of balancing your own personal needs with your relationships, while also fulfilling family responsibilities and playing a variety of different roles in society (depending on things like career, and the roles you might play in the community). A key part of these stages is marriage (or cohabitation), perhaps the most important relationship(s) of adulthood.

Love and Marriage

Listen to the Audio

Although not all long-term committed relationships proceed to marriage, it remains the norm, with about two-thirds of Canadian families involving a married couple (with or without children). The proportion of people who marry varies by societal trends and civil arrangement options (e.g., common-law marriage). Regardless, most adults pursue some kind of long-term relationship.

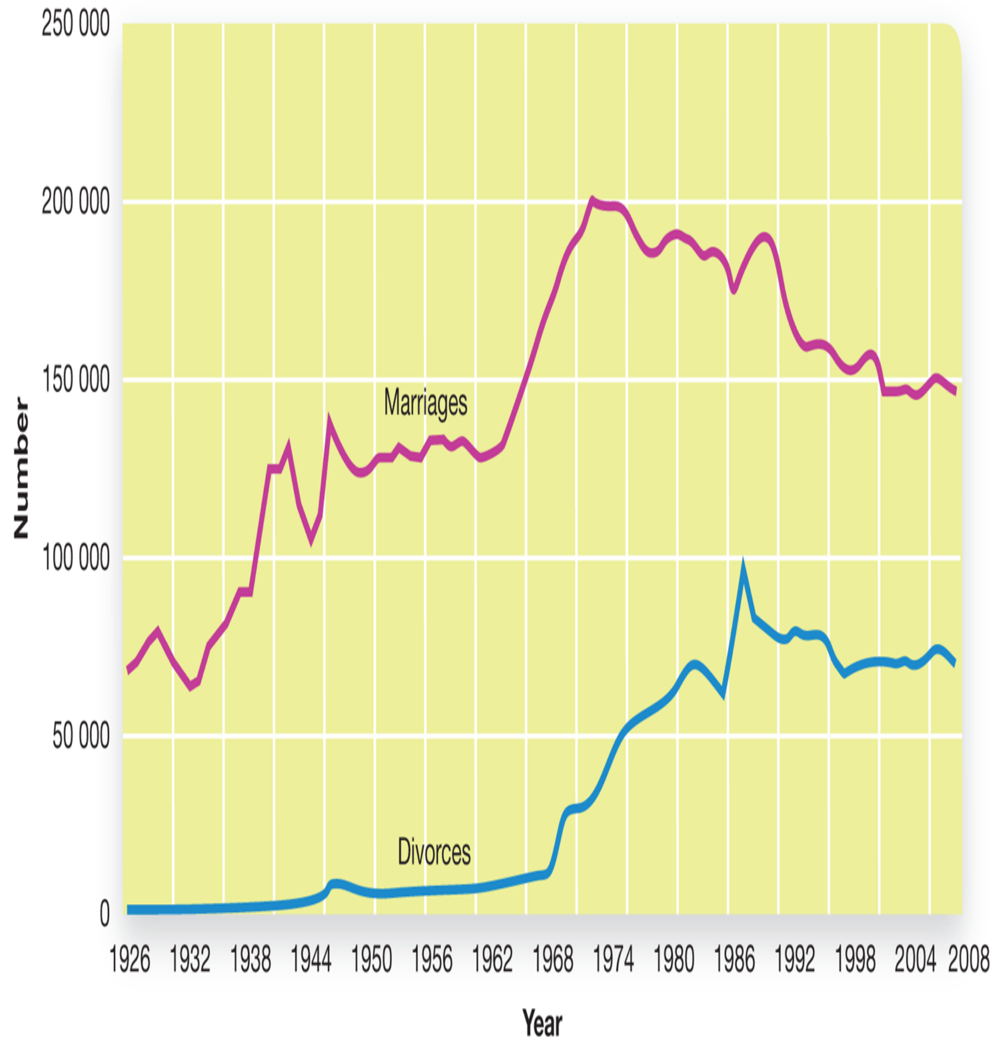
Consistent with Erikson's theorizing, being able to establish a committed, long-term relationship seems to be good for people (although not in all cases, such as abusive relationships). On average, being in such a relationship is associated with greater health, longer life (Coombs, 1991; Koball et al., 2010), and increased happiness (Wayment & Peplau, 1995). Numerous factors are involved in these benefits. For example, married couples encourage each other to stay active and eat healthier diets, are more satisfied with their sex lives (and have sex more frequently than those who stay single), and enjoy greater financial security (Waite & Gallagher, 2000).

But is it really *marriage* that makes people happier? Or is it due to living together in a committed relationship? Many people believe that living together before marriage is harmful to a relationship, whereas others believe it is a wise thing to do before making the commitment to marry a person. Until a few years ago, research suggested that despite the beliefs of more progressively minded folks, cohabiting before marriage appeared

to be associated with weaker relationships in a variety of ways (e.g., Stack & Eshleman, 1998). However, a dramatic reversal of this opinion occurred after a large international study of relationships in 27 countries (Lee & Ono, 2012) showed that the reason people in common-law relationships seem less happy, on average, is actually because of *cultural intolerance of these types of relationships*. In cultures with more traditional gender roles, cohabiting outside of marriage is frowned upon, and couples who do so suffer a social cost. This negatively affects women in particular, whose happiness depends more heavily on family relationships and interpersonal ties (Aldous & Ganey, 1999). In more egalitarian societies, common-law relationships are not judged as negatively, and consequently, there seems to be no cost to living with a partner before marriage. Indeed, many people would argue that it is a good idea, leading people to make better decisions when choosing a life partner.

Despite the promise of "until death do us part," about 40% of Canadian marriages end in divorce (Statistics Canada, 2004; see Figure 10.17). One of the key factors that determines whether a marriage will end, and the factor that we have the most control over, is how well partners in a relationship are able to communicate with each other, particularly when they are having a conflict. Several decades of behavioural studies by Dr. John Gottman looked at the communication patterns of couples and led to some key insights about what makes relationships break down and how relationship partners can prevent breakdowns from happening.

Figure 10.17 Marriage and Divorce Trends in Canada



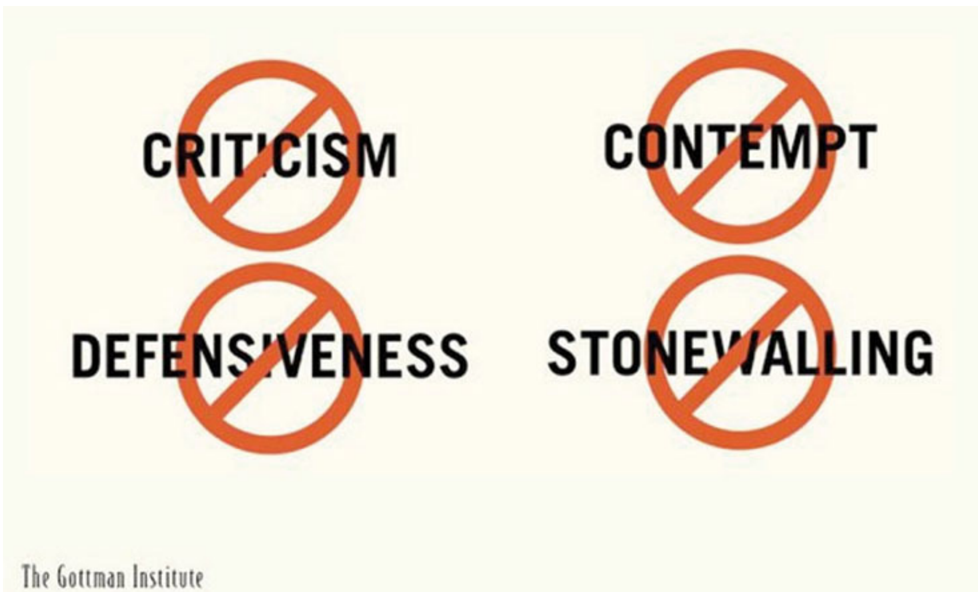
Starting in the 1960s, Canadian divorce rates began rising quickly. They have been fairly steady for the past 20 years.

Source: Statistics Canada. Divorce cases in civil court, 2010/2011, Juristat Article, Catalogue no. 85-002-X, 2012. Reproduced and distributed on an "as is" basis with the permission of Statistics Canada.

By observing a couple interacting in his wonderfully named "love lab," Gottman has been able to predict with up to 94% accuracy whether a relationship will end in divorce (e.g., Buehlman et al., 1992; Gottman & Levenson, 2002). Across multiple studies, certain patterns of behaviour are highly predictive of relationship break-up. He calls them, rather

dramatically, the *Four Horsemen of the (Relationship) Apocalypse* (Gottman & Levenson, 1992, 2002). They include:

- *Criticism:* picking out flaws, expressing disappointments, correcting each other, and making negative comments about a spouse's friends and family
- *Defensiveness:* responding to perceived attacks with counter-attacks
- *Contempt:* dismissive eye rolls, sarcastic comments, and a cutting tone of voice
- *Stonewalling:* shutting down verbally and emotionally



The Four Horsemen of the (Relationship) Apocalypse: Learning to recognize and change these negative communication patterns can make many relationships better.

Source: Recognizing the Four Horsemen of the (Relationship) Apocalypse. Reprinted with permission of the Gottman Institute at www.gottman.com.

Studying these four patterns of destructive communication is like studying a trouble-shooting manual for the relationships of early and middle adulthood. Avoid these patterns and nurture their opposing tendencies (such as understanding, empathy, and acceptance), and your

relationships will have a much better chance of being positive and fulfilling.

Parenting

Listen to the Audio

One common (although by no means universal) aspect of intimate relationships is the raising of children and having something you identify as “a family” together. This is one of the most powerful routes by which people experience a deepening in their feelings of being connected to others. Certainly, whether a person is ready for it or not, parenting basically forces you to become less self-centred. All of a sudden, there is another being who for many years will be utterly dependent on you for its survival and its healthy development.

The experience of becoming a parent, as with any other huge shift in life, causes a person to reorganize their identity to some degree. Life is not just about them anymore. And indeed, you would be miserable and feel terrible about yourself if you ignored your child, tending instead to your own completely independent needs.

Of course, making this transition—with the exhaustion, stress, and massive changes that accompany it—is not easy. As a result, research tends to show a rather sad pattern, but one worth examining nonetheless: within a fairly short period of time (usually around two years) of having children, parents typically report that their marital satisfaction declines (Belsky & Rovine, 1990). Other factors influence marital satisfaction among parents. For example, parents of high socioeconomic status are more negatively affected by parenthood than low socioeconomic groups, and younger parents, compared with people who have children at a later

age, also report lower marital satisfaction (Twenge et al., 2003). Marital satisfaction is usually highest before the birth of the first child, then is reduced until the children enter school (Cowan & Cowan, 1995; Shapiro et al., 2000), and not uncommonly, remains low until the children actually leave home as young adults themselves (Glenn, 1990). A major upside to this pattern of findings, of course, is that older adults are often poised to enjoy a rekindling of their relationship; their best years are still ahead of them, and they can settle into enjoying their relatively free time together. In fact, the notion of parents suffering in their *empty nest* once their children leave home is largely a myth. Married older adults are just as likely to report being "very satisfied" with marriage as newlyweds (Rollins, 1989). Of course, some parents no doubt take a fresh look at their relationship once it's just the two of them again and discover they no longer have anything in common or don't even like each other that much. But happily, the general trend is actually the opposite—couples find their relationships flourishing again. So, there can be a lot of things to look forward to as one gets older.

Late Adulthood

Listen to the Audio

The pursuit of happiness is a common theme in contemporary society, and certainly we can all relate to the desire to be happy. But how do we go about achieving "happiness" as we age, and are we generally successful?

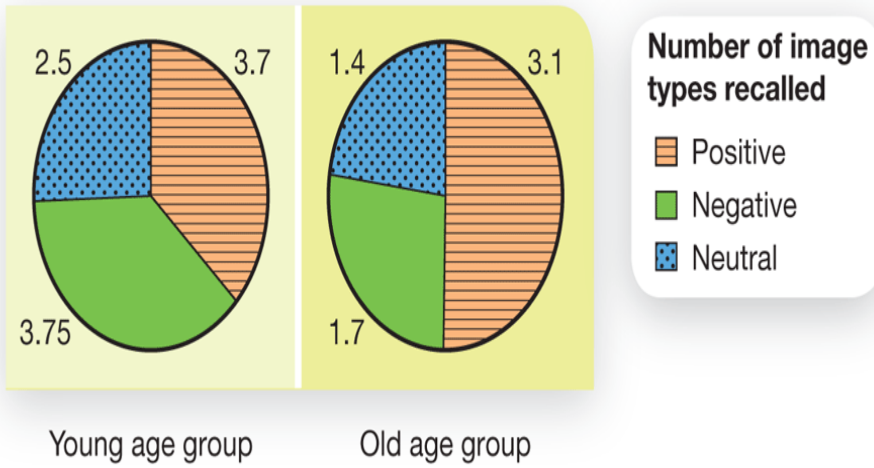
Happiness and Relationships

Listen to the Audio

One of the biggest benefits to growing older is that the emotional turmoil of youth, with its dramatic ups and downs (passions, despair, anger, lust, and all the rest), often gives way to a smoother, more emotionally stable, and generally more positive experience. As a result, late adulthood is often a particularly enjoyable time of life. The Buddhist monk Thich Nnat Hanh has described youth as being like the chaotic mountain stream tumbling down the mountainside, whereas old age is when the stream has broadened into a serene river making the final leg of its journey to the ocean.

Developmental psychologists describe a similar type of personal development through the lens of **socioemotional selectivity theory**, *which describes how older people have learned to select for themselves more positive and nourishing experiences*. Older people seem better able to pay more attention to positive experiences, and tend to take part in activities that emphasize positive emotions and sharing meaningful connections with others (Carstensen et al., 1999). The net result of this wiser approach to life is that negative emotions often decline with age, while positive emotions actually increase in frequency (Figure 10.18). Simply put, older people are (often) happier (Charles & Carstensen, 2009), which definitely gives us something to look forward to!

Figure 10.18 Emotion, Memory, and Aging



Younger people have superior memory for whether they have seen positive, negative, or neutral pictures compared with older people. However, notice that younger people remember positive and negative pictures equally, whereas older people are more likely to remember positive pictures (Charles et al., 2003).

Source: Data from Carstensen, L. L., & Mikels, J. A. (2005). At the intersection of emotion and cognition: Aging and the positivity effect. *Current Directions in Psychological Science*, *14*(3) 117—121.

Erikson's theory of psychosocial development describes the final stage, spanning approximately 65 years and onward, as *aging*, the challenge of *ego integrity versus despair*. During this time the older adult contemplates whether they lived a full life and fulfilled major accomplishments, and can now enjoy the support of their lifetime of relationships and social roles. In contrast, if they only look back on disappointments and failures, this will be a time of great personal struggle against feelings of despair and regret.

The full story of aging has a downside to it as well; it's not all sunshine and rainbows. Older people experience great challenges: the deaths of their spouse and family members, the loss of close friends and acquaintances, the fading of their physical capabilities, the loss of personal freedoms such as driving or living without assistance, and inevitable health challenges as the body ages. Existentially speaking, older adults also must, sooner or later, face the growing awareness that

their time on this earth is drawing to a close. It doesn't take a lot of imagination to understand why younger people often assume that the elderly are unhappy and depressed as they face the imminent "dying of the light." Certainly, depression and even suicide are not unknown to the elderly, although contrary to the stereotype of the unhappy, lonely old person, healthy older adults are no more likely to become depressed than are younger people. The reality is that as long as basic emotional and social needs are met, old age is often a very joyous time, again reflecting the greater wisdom with which older adults approach the challenges of their lives, making the best of things, focusing on what they can be grateful for, and letting things go that are negative, as much as possible (Charles & Carstensen, 2009). One of the key lessons that life teaches a person is that many of the challenges they face carry their own rewards and hidden benefits. In struggling to deal with the difficulties of life, people often find that they grow in many ways, such as shifting their priorities after realizing what really matters to them, feeling deeply grateful for their close relationships, and feeling deeply motivated to live authentically according to one's own personal values and sense of what is right (Tedeschi & Calhoun, 2004). Older people therefore have ample opportunities for personal growth, and it is important to respect how much of the later years of life can be a supremely rich time for people to invest in their own growth, learning, and practice. Even as death approaches, the benefits to the elderly can be a deep enriching of the gratitude they feel for being alive (Frias et al., 2011).

The Eventual Decline of Aging

Listen to the Audio

Of course, every story has its ending, and as much as we might like to avoid this topic, we also have to acknowledge that the later years of adulthood are accompanied by a certain amount of decline. The body declines and the mind eventually is not as sharp as it once was. Researchers have examined this in great detail and found that the brain, just like other physical systems, shows structural changes and some functional decline with age. These changes include reduced volume of white and grey matter of the cerebral cortex, as well as of the memory-processing hippocampus (Allen et al., 2005). The prefrontal cortex and its connections to subcortical regions are also hit hard by aging (Raz, 2000). The reduced frontal lobe volume may explain why older adults sometimes lose their train of thought and why they sometimes say things that they wouldn't have in the past (e.g., blunt comments, vulgarity). Because it is now common for people to live well into their 80s and beyond, these declines are ever more important to understand because they have many implications for how well older adults will be able to function in their everyday lives.

If you live well and/or are lucky, you can get pretty much to the end of a natural lifespan with very little cognitive decline. However, there is a lot of variability in how well people will age, neurologically speaking. The negative end of the spectrum is anchored by various *neurodegenerative* conditions. These are medical conditions of aging characterized by the loss of nerve cells and nervous system functioning, which generally

worsen over time. Many older adults struggle with attending to the tasks of everyday life, which may indicate the onset of **dementia**, *a mild to severe disruption of mental functioning, memory loss, disorientation, and poor judgment and decision making*. Approximately 14% of people older than 71 years of age have dementia.

Psych@

The Driver's Seat

Thanks to technology, the current generation of elderly adults faces issues that previous generations never did. Take driving, for example. Many older adults depend on their cars to shop, maintain a social life, and keep appointments. Research, however, has shown that the cognitive and physical changes in old age may take a toll on driving skill. This decline presents a dilemma for many seniors and their families: How can individuals maintain the independence afforded by driving without endangering themselves and other drivers?

To address this problem, psychologist Karlene Ball developed an intervention called Useful Field of View (UFOV) Speed of Processing training (Ball & Owsley, 1993). UFOV uses computer-based training exercises to increase the portion of the visual field that adults can quickly process and respond to. Laboratory studies show that UFOV actually increases the speed of cognitive processing for older adults (Ball & Owsley, 2000). Brain imaging work has shown that UFOV training enhances neural connections between regions involved in executive function (cognitive control) and visual attention (Ross et al., 2018). Records from several U.S. states that have studied

the UFOV show that drivers who completed the training were half as likely to have had an accident during the study period.

Dr. Karlene Ball, who developed the Useful Field of View with Dr. Daniel Roenker.

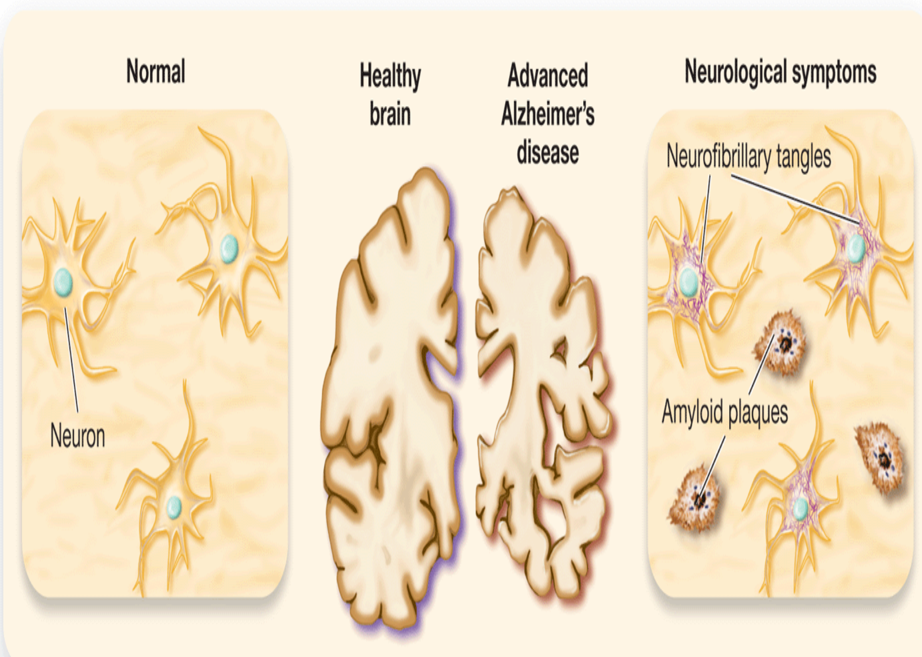
Courtesy of Dr Karlene Ball

Nearly 10% of cases of dementia involve the more severe **Alzheimer's disease**—*a degenerative and terminal condition resulting in severe damage to the entire brain*. Alzheimer's disease rarely appears before age 60, and it usually lasts 7 to 10 years from onset to death (although some people with Alzheimer's live much longer). Early symptoms include forgetfulness for recent events, poor judgment, and some mood and personality changes. As the disease progresses, people experience severe confusion and memory loss, eventually struggling to recognize even their closest family members. In the most advanced stages of Alzheimer's disease,

affected individuals may fail to recognize themselves and may lose control of basic bodily processes such as bowel and bladder control.

What accounts for such extensive deterioration of cognitive abilities? Alzheimer's disease involves a buildup of proteins that clump together in the spaces between neurons, interrupting their normal activity. These are often referred to as *plaques*. Another type of protein tangles within nerve cells, which severely disrupts their structural integrity and functioning (Figure 10.19). These are often referred to as *neurofibrillary tangles* (or simply as *tangles*). Many research groups are currently searching for specific genes that are associated with Alzheimer's disease.

Figure 10.19 How Alzheimer's Disease Affects the Brain



Advanced Alzheimer's disease is marked by significant loss of both grey and white matter throughout the brain. The brain of a person with Alzheimer's disease typically has a large buildup of a protein called beta-amyloid, which kills nerve cells. Also, tau proteins, which maintain the

structure of nerve cells, are often found to be defective in the Alzheimer's brain, resulting in neurofibrillary tangles.

Source: Based on information from National Institute of Aging. (2008). Part 2: What happens to the brain in AD. In *Alzheimer's Disease: Unraveling the Mystery*. U.S. Department of Health and Human Services. NIH Publication No. 08-3782. Retrieved from www.nia.nih.gov/sites/default/files/alzheimers_disease_unraveling_the_mystery_2.pdf

Alzheimer's disease illustrates a worst-case scenario of the aging brain. However, even in normal brains, structural changes occur that also cause a variety of cognitive challenges that increase as the person gets older.

Working the Scientific Literacy Model

Aging and Cognitive Change

Listen to the Audio

How does the normal aging process affect cognitive abilities such as intelligence, learning, and memory? People commonly believe that a loss of cognitive abilities is an inevitable part of aging, even for those who do not develop dementia or Alzheimer's disease. However, the reality of aging and cognition is not so simple.

What do we know about cognitive abilities?

There are many different cognitive abilities, such as attention, memory, problem solving, and language. One useful distinction is made between cognitive tasks that involve processes such as problem solving, reasoning, processing speed, and mental flexibility; these tasks are said to involve *fluid intelligence*. Other tasks tap into *crystallized intelligence*, which is based on accumulated knowledge and skills (Module 9.2), such as recognizing famous people like David Suzuki or Justin Bieber. Although fluid intelligence reaches a peak during young adulthood and then slowly declines, crystallized intelligence remains largely intact into old age.

How can science explain age-related differences in cognitive abilities?

Researchers have not yet fully solved the riddle of why some cognitive abilities decline with age. There are many potential explanations. Neurological studies of brain function suggest two leading possibilities.

The first is that older adults sometimes use ineffective cognitive strategies, leading to lower levels of activation of relevant brain areas. This has been repeatedly found in various studies (e.g., Logan et al., 2002; Madden et al., 1996). Interestingly, it may be possible to enhance neural function in older people simply by reminding them to use effective strategies. For example, Logan and her colleagues (2002) found that, compared to subjects in their 20s, older subjects (in their 70s and 80s) performed worse on a memory task and showed less activity in key frontal lobe areas. However, by giving older adults strategies to help them more deeply encode the information, older adults were able to activate these brain areas to a greater extent, thus improving their memories for the information. This work suggests that a key to helping older adults resist the decline of their cognitive abilities is to help them learn effective strategies for making better use of their cognitive resources.

A second possible explanation for reduced cognitive abilities in older people is that older brains show more general, non-specific brain activation for a given task (Berlingeri et al., 2013; Cabeza, 2002). They may do so either because they are compensating for deficits in one area by recruiting other areas, or possibly because they are less capable of limiting activation to the appropriate, specialized neural areas. Involving more widely distributed brain areas in a given task would generally result in slower processing speed, which could help to explain some of the cognitive deficits (e.g., fluid intelligence) seen in older adults.

Can we critically evaluate our assumptions about age-related cognitive changes?

Although older people show declines on laboratory tests of some cognitive functions, we should guard against the stereotypic assumption that the elderly are somehow less intellectually capable than the rest of us. In most cultures and for most of history, older people have been widely respected and honoured as wisdom keepers for their communities. Respect for your elders is, in fact, the historical norm, whereas modern Western society's tendency to disregard the perspectives of the elderly, assuming that they are out of touch and their opinions are no longer relevant, is the aberration.

The wisdom of elderly people is evident in their approach not only to emotional well-being, as we discussed earlier in this module, but also in how they deal with their own cognitive abilities. In everyday life, as opposed to most laboratory tests, the decline in cognitive abilities does not necessarily translate into decline in practical skills, for at least two important reasons. The first is that while the episodic and working memory systems may not work as well, the procedural and semantic memory systems show a much slower rate of decline with age (see Figure 10.20). Thus, older people's retention of practical skills and general knowledge about the world remains largely intact for most of their lives.

Figure 10.20 Memory and Aging

Several types of memory systems exist, not all of which are equally affected by age. An older person's ability to remember events, such as words that appeared on a list (episodic memory), is more likely to decline than his or her memory for facts and concepts (semantic memory).

The second reason the elderly fare better than might be expected from laboratory tests is that they learn to compensate for their reduced raw cognitive power by using their abilities more skillfully. For example, in a chess game, older players play as well as young players, despite the fact that they cannot remember chess positions as well as their young opponents. They compensate for this reduction in working memory during a game by more efficiently searching the chessboard for patterns (Charness, 1981). Having more experience to draw upon in many domains of life gives older people an advantage because they will

be better able to develop strategies that allow them to process information more efficiently (Salthouse, 1987).

Why is this relevant?

In a society that increasingly relegates its elderly to seniors' residences, largely removing them from their families and the larger community, it is important to remember that older people actually retain their faculties much better than might be expected. This is especially true for older adults who practise specific cognition-enhancing behaviours. What keeps the aging brain sharp? It's pretty simple really, as researchers at the University of Alberta and others have shown—staying physically active, practising cognitively challenging activities (and they don't have to be crosswords and brain teaser puzzles; intrinsically enjoyable hobbies work just fine), and remaining socially connected and active (Small et al., 2012; Stine-Morrow, 2007). In addition, diets low in saturated fats and rich in antioxidants, omega-3 fatty acids, and B vitamins help to maintain cognitive functioning and neural plasticity (Mattson, 2000; Molteni et al., 2002). As a society, providing opportunities and resources for seniors to remain active, socially engaged, and well-nourished will allow them to enjoy high-quality lives well into old age.

Module 10.4 Summary

Listen to the Audio

10.4a Know . . . the key terminology concerning adulthood and aging.

Review Module 10.4

Start Over Swap

0/4 REVIEWED · 0 MASTERED

Alzheimer's disease

Previous Next Got It!

10.4b Know . . . the key areas of growth experienced by emerging adults.

People making the transition from adolescence to adulthood face substantial life challenges that contribute to personal growth in three

main areas: relationships (i.e., cultivating true intimacy and trust); new possibilities (i.e., exploring what they really want to do with their lives and choosing a compatible path that reflects their interests); and personal strengths (i.e., the skills and competencies that come from successfully facing challenges).

10.4c Understand . . . age-related disorders such as Alzheimer's disease.

Alzheimer's disease is a form of dementia that is characterized by significant decline in memory, cognition, and, eventually, basic bodily functioning. It seems to be caused by two different brain abnormalities—the buildup of proteins that clump together in the spaces between neurons, plus degeneration of a structural protein that forms tangles within nerve cells.

10.4d Understand . . . how cognitive abilities change with age.

Aging adults typically experience a general decline in cognitive abilities, especially those related to fluid intelligence, such as working memory. However, older adults also develop compensatory strategies that enable them to remain highly functional in their daily lives, despite their slow decline in processing capability.

10.4e Apply . . . your attitudes about marriage.

Apply Activity

As discussed in this module, attitudes about marriage can change over time. Attitudes about marriage also vary by individual and culture. For these reasons, researchers develop standardized scales for measuring attitudes about marriage. Below is a modified version of Park and Rosén's

(2013) General Attitudes Toward Marriage Scale. Total your score and compare with others.

Rate the following statements on a 0-6 scale (0 = strongly disagree, 1 = moderately disagree, 2 = slightly disagree, 3 = neither disagree or agree, 4 = slightly agree, 5 = moderately agree, 6 = strongly agree).

1. Marriage is beneficial.
2. I am not fearful of marriage.
3. People should marry.
4. I have no doubts about marriage.
5. Marriage is a "good idea."
6. Marriage makes people happy.
7. Most marriages are happy situations.
8. Marriage is important.

10.4f Analyze . . . the stereotype that old age is a time of unhappiness.

Research shows that older adults do face issues that might lead to unhappiness—for example, health problems, loss of loved ones, and reductions in personal freedom. However, such challenges often lead to growth and a deepened appreciation for life and other people. The result is that many older people become skilled at focusing on the positives of life and pay less attention to the negatives, leading to an *increase* in life satisfaction, rather than a decrease.

Chapter 11
Motivation and Emotion

Listen to the Audio

11.1 Hunger and Eating

- Physiological Aspects of Hunger
- Psychological Aspects of Hunger
- Disorders of Eating
- Working the Scientific Literacy Model: The Effect of Media Depictions of Beauty on Body Image
- Module 11.1 Summary

11.2 Sex

- Human Sexual Behaviour: Evolutionary Influences
- Human Sexual Behaviour: Psychological Influences
- Human Sexual Behaviour: Physiological Influences
- Working the Scientific Literacy Model: Sexual Orientation and the Brain
- Human Sexual Behaviour: Cultural Influences
- Module 11.2 Summary

11.3 Social and Achievement Motivation

- Belonging and Love Needs

Achievement Motivation

Working the Scientific Literacy Model: Terror Management Theory and the Need to Belong

Module 11.3 Summary

11.4 Emotion

Physiology of Emotion

Experiencing Emotions

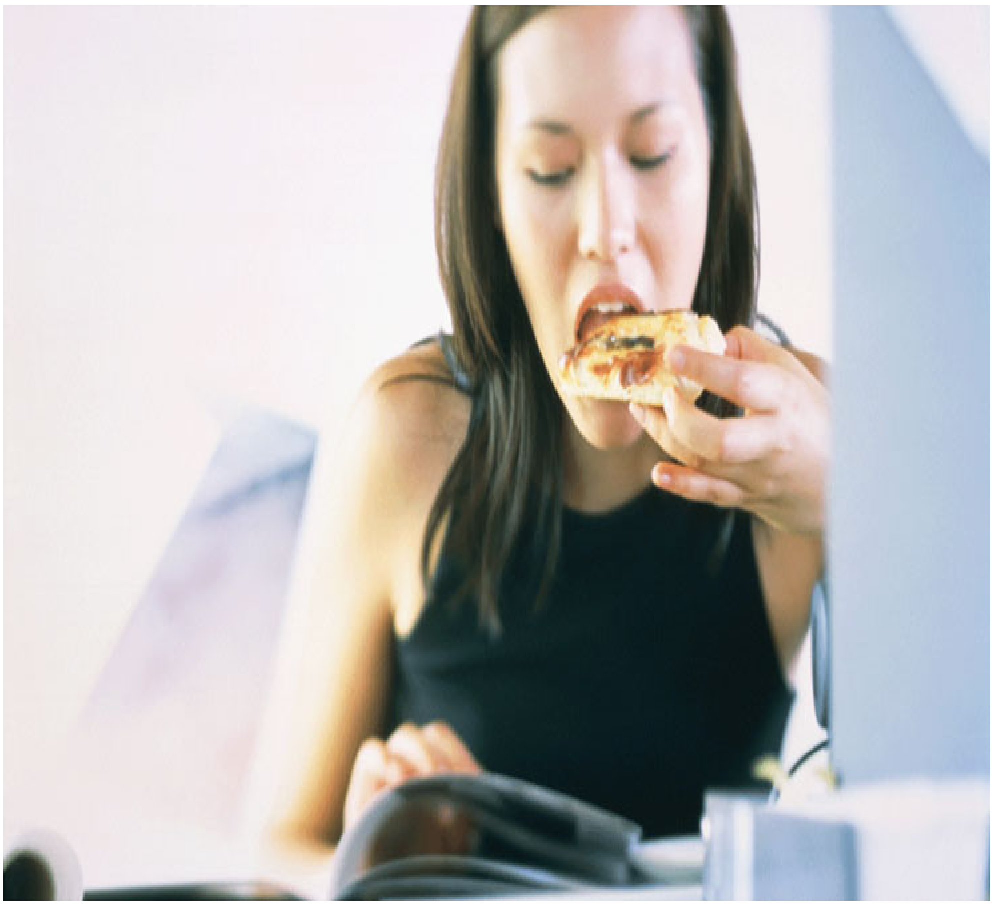
Working the Scientific Literacy Model: The Two-Factor Theory of Emotion

Expressing Emotions

Module 11.4 Summary

Module 11.1 Hunger and Eating

Listen to the Audio



Satchan/Corbis/Bridge/Glow Images

Learning Objectives

11.1a Know . . . the key terminology of motivation and hunger.

11.1b Understand . . . the biological, cognitive, and social processes that shape eating patterns.

11.1c Understand . . . the causes of common eating disorders.

11.1d Apply . . . your knowledge of hunger regulation to better understand and evaluate your own eating patterns.

11.1e Analyze . . . the role of the media on people's body image.

It was Janice's first year of university. She'd made it through the first three months of the semester with impressive grades, but was now dealing with her first ever set of final exams. After a long afternoon of studying history, Janice felt like she was starving. She walked over to the cafeteria and was overwhelmed by the number of options. She saw a friend eating a greasy pizza and immediately ordered one for herself (but with a salad, which of course made the meal healthy). She finished the enormous plate of food and felt like she couldn't eat another bite. She crawled back to the library and began studying for her chemistry exam that was scheduled for the next morning. But, despite having just eaten a large meal, Janice found herself munching on candy that she'd snuck into the library (a guilty habit that was now as much a part of studying as her textbooks). The more anxious she got about this exam, the more she mindlessly moved the sugary snacks from their bag into her mouth.

Janice's experience shows us that eating isn't just a simple behaviour we use for survival. Hunger is a biological drive that influences what we pay attention to and interacts with our past experiences and current mental states such as excitement and anxiety. Hunger is a psychological behaviour.

Although this module focuses on behaviours related to eating and hunger, it also serves as an introduction to the concept of motivation.

Motivation *concerns the physiological and psychological processes underlying the initiation of behaviours that direct organisms toward specific goals*. These initiating factors, or *motives*, can take many forms. They can involve satisfying bodily needs such as drinking when you are thirsty, but they can also include social behaviours such as seeking out other people when you are lonely. The fact that you are reading Chapter 11 of a university text shows you another type of motivation—you are likely motivated to achieve academic success. In all of these cases, a behaviour is being initiated in order to complete some sort of goal-directed behaviour.

At its most basic level, motivation is essential to an individual's survival because it contributes to **homeostasis**, *the body's physiological processes that allow it to maintain consistent internal states in response to the outer environment* (see Figure 11.1). For example, when the body's water levels fall below normal, cells release chemical compounds that maintain the structure and fluid levels of cells. Receptors in the body respond to the increased concentrations of these compounds, as well as to the lower water volume, and send messages to the brain. The result is the sudden awareness that you are thirsty, which motivates you to drink water. This process is known as a **drive**, *a biological trigger that tells us we may be deprived of something and causes us to seek out what is needed, such as food or water* (Figure 11.2). The *stimuli we seek out in order to reduce drives* are known as **incentives**. In this example, the incentive would be water; however, in other modules, incentives will range from sex (see Module 11.2) to feeling like you belong, or even to a more abstract feeling of reaching your potential as a human (see Module 11.3).

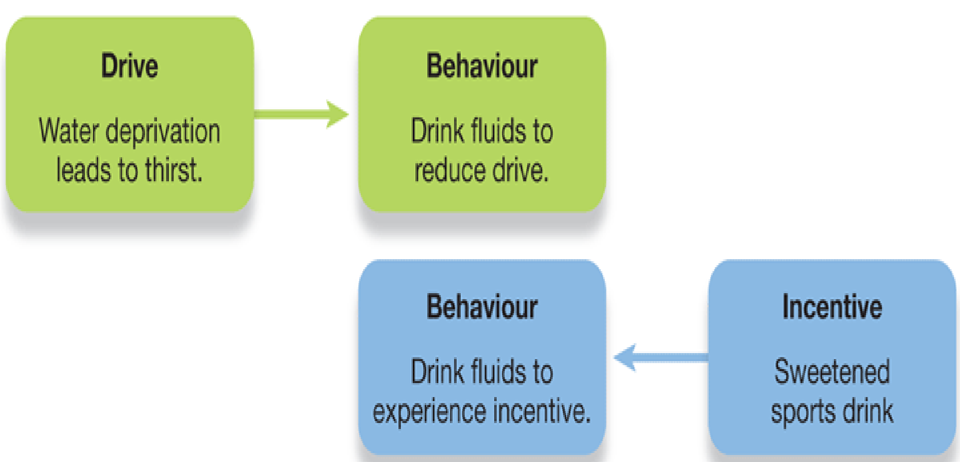
Figure 11.1 Maintaining Balance

Homeostasis is the process of maintaining relatively stable internal states. Click on each circle to see how homeostasis regulates thirst and the body's fluid levels.

The body detects that fluid levels are low and send signals to the brain that motivate us to drink; once fluid levels are normal, this motivation decreases. A pack of psychology professors are, of course, just out of view in this photo, battling a group of Kenyans for third place.

Source: Mark Wilson/The Boston Globe/Getty Images

Figure 11.2 Drives and Incentives



Our motivation to reduce a drive, as well as our response to an incentive, can lead to the same behaviour.

There are times, however, when our behaviours cannot be explained by a desire to reach a state of homeostasis. Instead, our motivations are influenced by an internal or external source of stress. Stress often leads us to use more resources than we normally would. Stress is particularly challenging to our homeostasis because it is difficult to predict how long you will be in that energy-consuming state—you don't schedule stress into your day planner. As a result, our motivational systems have to make a prediction about the resources that our bodies will require, and then initiate motivational behaviours that will drive us to acquire those resources. This process is known as **allostasis**, *motivation that is not only influenced by current needs, but also by the anticipation of future needs caused by stress* (Sterling, 2011).

To make the relationship between homeostasis and allostasis more concrete, let's think back to the example of Janice eating candy while stressing out about her exams. The experience of anxiety used a lot of Janice's energy, as did the effort required to control her emotions. If Janice didn't increase her food consumption to meet these new energy demands, her energy level would quickly dip below optimal levels. As a result, her physical and mental well-being would then suffer. So, if Janice were not stressed out, homeostasis would drive her toward consuming a particular number of calories; however, allostasis—which involves the influence of stress on homeostasis—would drive her to consume a greater number of calories (and would be *one* reason why she was snacking).

Of course, our ability to predict our future needs is not perfect, which explains why psychological variables (e.g., stress, desire to appear attractive, the need to feel "in control") can have such a strong influence on behaviours like eating and drinking, which don't seem "psychological"

at all. In this module, we will examine how these physical and psychological factors influence our motivation to eat. We will also examine how social factors can alter our eating habits in negative and self-destructive ways.

Physiological Aspects of Hunger

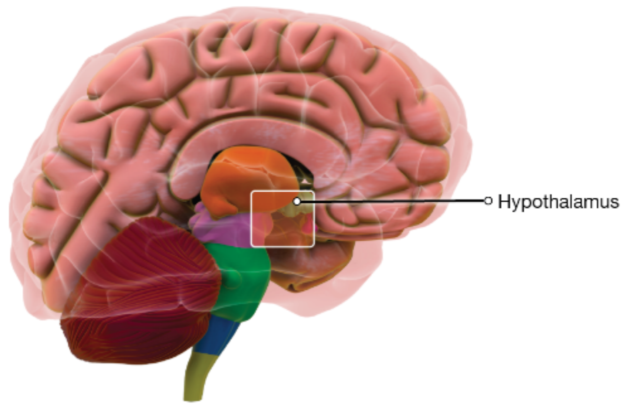
Listen to the Audio

Hunger is not simply a homeostatic mechanism. The need to consume enough nutrients so that you have enough energy to function involves physiological responses *as well as* more complex cognitive and emotional factors (Dagher, 2012). The brain areas involved with these factors interact with the brain areas that control our appetites.

The “on” and “off” switches involved in hunger can be found in a few regions of the **hypothalamus**, *a set of nuclei found on the bottom surface of the brain that are involved in regulating motivation and homeostasis by stimulating the release of hormones throughout the body*. Researchers have found that electrically stimulating the *lateral hypothalamus* causes rats to begin to eat; thus, this structure may serve as an “on” switch (Delgado & Anand, 1952; Stuber & Wise, 2016). In contrast, stimulating the *ventromedial hypothalamus* causes rats to stop eating. Damaging the ventromedial region removes the “off" switch in the brain. In lab animals, this damage leads to obesity because the animals don’t stop eating (Figure 11.3). A related area, the *paraventricular* nucleus of the hypothalamus, also signals that it is time to stop eating by inhibiting the lateral hypothalamus.

Figure 11.3 The Hypothalamus and Hunger

The Hypothalamus



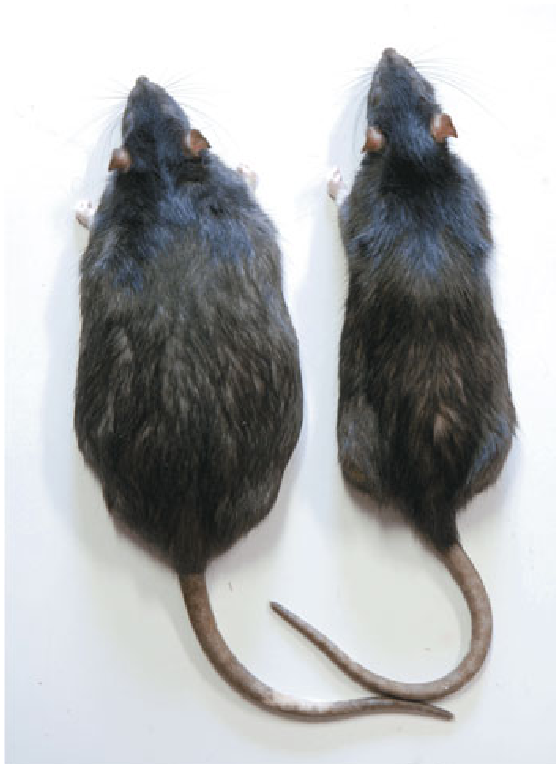
The hypothalamus acts as an on/off switch for hunger.

On/Off Switches of Hunger

Source: From Weiten, W. (2013). *Psychology*, 9e. © 2013 South-Western, a part of Cengage Learning, Inc. Reproduced by permission. www.cengage.com/permissions.

The activity of the hypothalamus is influenced by hormones that are released in response to the energy needs of your body. So, your brain influences your body *and* your body influences your brain! A key function of the hypothalamus is to monitor blood chemistry for indicators of the levels of sugars and hormones necessary for you to have enough energy to function. For example, the hypothalamus detects changes in the level of **glucose**, *a sugar that serves as a primary energy source for the brain and the rest of the body*. Highly specialized neurons called glucostats can detect glucose levels in the fluid outside of the cell. If these levels are too low, glucostats signal the hypothalamus that energy supplies are low, leading to increased hunger (Langhans, 1996a, 1996b). After food reaches the stomach and intestines, sugars are absorbed into the bloodstream and are transported throughout the body. Insulin, a hormone secreted by the pancreas, helps cells store this circulating glucose for future use. As

insulin levels rise in response to consumption of a meal, hunger decreases—but so do glucose levels, which, after a few hours, leads to hunger again.



The rat on the left has swollen to enormous proportions after researchers created lesions to its ventromedial hypothalamus. Compare it to the more typical rat on the right.

Voisin/Phanie/Photo Researchers, Inc./Science Source

Of course, if our motivation to eat was based entirely on the relationship between glucose and the hypothalamus, then our eating behaviours would be quite simple: we'd consume whatever food was available until our need for glucose was satisfied. We all know that is not the case. Eating is influenced by a number of other factors, including the characteristics of the available food and how much of it we have already eaten.

Food and Reward

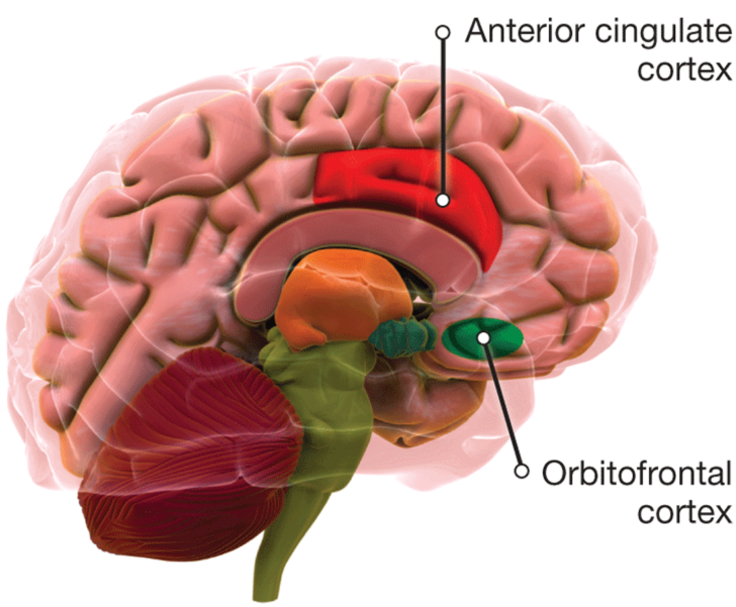
Listen to the Audio

In the example that started this module, poor stressed-out Janice ate pizza, salad, and candy. But humans evolved in environments in which food was not this plentiful or rich in variety. Sometimes, after a successful hunting expedition, food was abundant; however, at other times, food was quite scarce. Humans quickly learned that the best strategy was to "eat while you can" because there was no guarantee that another meal would be forthcoming any time soon. And, given that we need a great deal of energy to keep our bodies functioning properly, it would make sense to consume fatty foods, a very rich source of energy. Over the course of evolution, our bodies responded to this need with a number of systems that made the consumption of high-energy foods pleasurable. In other words, we developed bodies that were hard-wired to *like* some foods more than others.

Imagine eating poutine, Québec's cardiovascular equivalent of Russian roulette. It's clearly bad for you (there is no diet poutine), yet people still enthusiastically eat it. Indeed, some of the most popular foods in Canada are loaded with fats, including red meat, cheese, ice cream, and anything deep-fried. Psychologists and neuroscientists are discovering why people can be so driven to consume these and other fattening foods. Scientists suggest that we crave fats because we have specialized receptors on the tongue that are sensitive to the fat content of food. Research with animals shows that these receptors send messages to the brain that stimulate the release of endorphins and dopamine, both of which are responsible for

the subjective sense of pleasure and reward (Mizushige et al., 2007). Similar results were found in brain imaging studies with human participants (Rolls, 2010). In one study, participants had their brains scanned while they tasted various substances. At different times, the participants tasted either a fatty solution (vegetable oil), sucrose (a sweet taste), or a tasteless control substance. Brain activity was recorded while these different taste stimuli were delivered in liquefied form into the mouths of the participants through a small plastic tube. The participants were also asked to rate the pleasantness of each stimulus. Overall, the participants rated the fatty substance favourably, and the brain scans showed activity in regions of the brain associated with pleasure sensations when they tasted fat (de Araujo & Rolls, 2004; see Figure 11.4).

Figure 11.4 The Pleasure of Taste



When fat receptors of the tongue are stimulated, the cingulate cortex—a region of the brain involved in emotional processing—is activated. The orbitofrontal cortex is involved in linking food taste and texture with reward. Interestingly, activity in this region, along with reward centres in the basal ganglia, decreases when we are no longer motivated to eat.

In some situations, high-energy food can be a more powerful reinforcer than highly addictive drugs (Christensen et al., 2008). Some people even report cravings for a *sugar fix*—a term that seems to imply that addiction to candy and chocolate bars is comparable to an addiction to a drug like heroin. The phrase *sugar fix* may seem an exaggeration, but is it possible that sugar actually does act like a drug? Sugar and some addictive drugs share at least two interesting similarities. First, recreational drugs and sugary foods can both be described as *supernormal stimuli*—the stimuli are more intense than our bodies evolved to typically experience (Tinbergen, 1989). As an example, compare the sugar levels found in fruit and artificial foods like chocolate bars or jelly beans. Artificial foods are often much more intense. Second, ordinary sucrose—plain white granulated sugar—can stimulate release of the neurotransmitter dopamine in the nucleus accumbens, a brain region associated with the reinforcing effects of substances such as amphetamines and cocaine (Rada et al., 2005; see Module 5.3).

Dopamine plays a role in a number of eating-related behaviours. Our cravings for food, as well as our feeling of satisfaction when we taste this food, both lead to dopamine release. But dopamine plays an additional role in the motivation to eat. When food reaches our stomachs, dopamine is again released, this time in areas of the cortex related to higher cognitive functions (Thanarajah et al., 2018). This reaction suggests that food can lead to two different reward responses—one when we taste a food and one when we are digesting it.

Cells in the orbitofrontal cortex respond to perceptual qualities of food texture, such as the difference between a runny spaghetti sauce and a thick one.

Michele Cozzolino/Shutterstock

Of course, the reward value of food is also influenced by how much of it we have consumed—even the most stressed-out student will stop eating eventually. Indeed, we have all experienced the feeling of being "full." A full stomach is one cue for **satiation**—*the point in a meal when we are no longer motivated to eat*. That feeling is caused, in part, by *cholecystokinin* (mercifully abbreviated to CCK) (Badman & Flier, 2005). Neurons release CCK when the intestines expand. The ventromedial hypothalamus receives this information and decreases appetite. Scientists at the Montreal Neurological Institute used neuroimaging to investigate how satiation and the reward value of food might be linked. These researchers scanned people's brains while feeding them pieces of chocolate. At first, the participants rated the chocolate as being quite tasty and pleasurable; this led to activity in reward centres in the orbitofrontal cortex (the part of the frontal lobes just above your eyes) and basal ganglia (Small et al.,

2001). Activity was also found in the insula, which receives information about taste. But after participants had consumed several pieces of chocolate, this formerly pleasurable food became less appealing (i.e., they became “sick of it”). Interestingly, as participants’ ratings of the chocolate became more negative, the activity in reward centres decreased. This study shows us that our physiological and psychological motivations to eat influence each other.

Psychological Aspects of Hunger

Listen to the Audio

The previous section of this module described a number of biological influences on our motivation to eat. In this section of the module, we highlight cognitive and social factors that affect this important behaviour.

Eating and Cognition

Listen to the Audio

The quantity of food that we eat is not entirely controlled by the brain or by evolutionary mechanisms. We are also influenced by cognitive factors that affect our perceptual judgments and decision making. One example of a cognitive influence on eating is the **unit bias**, *the tendency to assume that the unit of sale or portioning is an appropriate amount to consume*. In some cases, this assumption works well. A single banana comes individually wrapped and makes for a healthy portion; it is an ideal unit (Geier et al., 2006). In contrast, packaged foods often come in sizes that are too large to be healthy. A bottle of pop today is likely to be 600 mL, but a few decades ago the same brand came in a 177 mL bottle. Despite the huge difference in volume, each is seen as constituting one unit of pop. As a consequence, you are now likely to consume more than three times as much pop in one sitting as your grandparents would have.

Compare a modern soft drink serving (top) to the historical serving size (bottom). Despite the massive increase in volume, modern consumers still consider the unit of packaging as a normal-sized serving.

Top: Image Source/Corbis; bottom: Akg-images/Newscom

This expansion of portion sizes—and waistlines—is being felt worldwide. As North-American-style fast-food chains expand into Asia, the prevalence of diabetes has increased (Pan et al., 2012). This trend is likely why some countries limit portion sizes and others, such as France, require

all fast-food chains and snack products to have warning labels. Psychologists have also found that focusing attention on the moment-by-moment experience of eating can affect how much we consume. People who use this *mindful eating* technique engage in less impulsive eating and choose healthier snacks (Jordan et al., 2014). These interventions are specifically designed to combat the attentional and cognitive factors that motivate us to eat too much.

Eating and the Social Context

Listen to the Audio

In addition to physiological and cognitive influences, food intake is affected by social motives as well. Have you ever gone to a party feeling not a hint of hunger, yet spent the first hour sampling each of the snacks laid out on the dining room table because you were nervous and didn't know what else to do with yourself? Whether the presence of other people increases or decreases our motivation to eat is influenced by the social situation (Herman, 2015). Here are a few examples:

- *Social facilitation: Eating more.* Dinner hosts (and grandmothers) may encourage guests to take second and even third helpings, and individuals with a reputation for big appetites will be prodded to eat the most. Perhaps the strongest element of social facilitation is just the time spent at the table: The longer a person sits socializing, the more likely he or she is to continue nibbling (Berry et al., 1985).
- *Impression management: Eating less.* Sometimes people self-consciously control their behaviour so that others will see them in a certain way—a phenomenon known as *impression management*. For example, you probably know that it is polite to chew with your mouth closed. Similarly, the *minimal eating norm* suggests that another aspect of good manners—at least in some social and cultural settings—is to eat small amounts to avoid seeming rude (Herman et al., 2003).
- *Modelling: Eating whatever they eat.* At first exposure to a situation, such as a business dinner, a new employee may notice that no one eats much and everyone takes their time. The newcomer will see the

> others as models, and so they too will restrain their eating. Later, the person may drop by a friend's family reunion where everyone is having a second or third helping and undoing their belts so their stomachs can expand more. In this case, the person will be likely to eat more, even if they are already feeling full (Herman et al., 2003).

Clearly, eating is not just a matter of maintaining homeostasis. It is best described as a behaviour motivated by biological, cognitive, and social psychological factors.

Disorders of Eating

Listen to the Audio

Our dietary habits are influenced by biological dispositions, our beliefs and perceptions about eating and our bodies, as well as sociocultural factors. Unfortunately, these motivational systems do not always lead us to good health. The past few decades have seen a dramatic rise in the rates of **obesity**, *a disorder of positive energy balance, in which energy intake exceeds energy expenditure*. Indeed, over the last 15 years, surveys have consistently shown that approximately 60% of males and 45% of females are overweight or obese (extremely overweight; Statistics Canada, 2016). However, in some individuals, hunger-related motivations move in the opposite direction—leading them to under-eat. While skipping dessert at Dairy Queen might not be a bad idea, avoiding or restricting the consumption of healthy food is obviously problematic. In the next section, we discuss some of the motivations underlying disorders affecting the motivation to eat.

Anorexia and Bulimia

Listen to the Audio

Approximately 1.5% of Canadian females aged 15 to 24 have some form of eating disorder (Government of Canada, 2006). The two most common forms of eating disorders are anorexia nervosa and bulimia (see Table 11.1). **Anorexia nervosa** *is an eating disorder that involves (1) self-starvation, (2) intense fear of weight gain and dissatisfaction with one's body, and (3) denial of the serious consequences of severely low weight*. In contrast, **bulimia nervosa** *is an eating disorder that is characterized by periods of food deprivation, binge-eating, and purging*. The periods of binging involve short bursts of intense calorie consumption. These are followed by purging (generally self-induced vomiting), fasting, laxative or diuretic use, and/or intense exercise. Both disorders usually occur during mid to late adolescence and have been on the rise since the 20th century. They are frequently diagnosed alongside mood or anxiety disorders (Hudson et al., 2007).

Table 11.1 Statistical Characteristics of Eating Disorders

Table 11.1 Statistical Characteristics of Eating Disorders

Lifetime prevalence of anorexia	Women: 0.9% Men: 0.3%
Lifetime prevalence of bulimia	Women: 1.5% Men: 0.5%
	Women and Men Combined
Percentage of people with anorexia who are receiving treatment	34%
Percentage of people with bulimia who are receiving treatment	43%
Average duration of anorexia	1.7 years
Average duration of bulimia	8 years

The incidence of eating disorders in Canadians is similar to that of other Western nations. To put these numbers into a global perspective, a 2004 study found that the incidence rate of anorexia varied from 0.1% to 5.3% in females in Western countries (no male data were available). Bulimia rates ranged from 0.3% to 7.3% (Norway) in females in Western countries and from 0.46% to 3.2% in non-Western countries (Makino et al., 2004). Thanks to researchers working with government agencies, prevention programs are now in place in all Western and most non-Western countries.

Source: Data from Hudson, J., Hiripi, E., Pope, H., & Kessler, R. (2007). The prevalence and correlates of eating disorders in the National Comorbidity Survey replication. *Biological Psychiatry*, *61*, 348–358.

Studies of these disorders have found that bulimia is marked by a tendency to be impulsive, whereas anorexia is not (Matsunaga et al., 2000). Bulimics are also much more likely to enter treatment programs because they find the binge–purge cycle disturbing. Anorexics, on the other hand, often appear indifferent to the negative effects of food deprivation on their health (Polivy & Herman, 2002). Although there are clear differences between anorexia and bulimia, both involve changes in

the motivation to eat and both are dangerous. A critical question, then, is: Why do eating disorders develop in some people but not others?

One factor is stress. Patients with eating disorders report greater levels of premorbid (before the disorder began) life stress than do age- and gender-matched individuals without eating disorders (Schmidt et al., 1997). These life stresses tend to make people feel as though they have no control over their lives. However, stress alone isn't enough to create an eating disorder. Instead, the perceived loss of control interacts with psychological variables such as depression, guilt, anxiety, and perfectionism (Vohs et al., 1999); low self-esteem (Button et al., 1996); and/or suppressed anger (Geller et al., 2000). This *combination* of stress and psychological vulnerability dramatically increases the chances of developing an eating disorder (Ball & Lee, 2002; Raffi et al., 2000).

There are also a number of social factors that can lead to eating disorders. Peer influence is often viewed as the number-one cause of these conditions (Stice, 1998). Adolescents, particularly females, learn attitudes and behaviours from their friends. This learning comes in the form of examples and encouragement, as well as from teasing and nasty remarks when an individual doesn't live up to the idealized (thin) standards depicted in the media (Levine et al., 1994). In fact, numerous proanorexia websites have emerged over the past decade, offering "thinspiration" for people engaging in extreme dieting. Similar messages now appear on social media sites such as Pinterest and Reddit. By posting photographs and messages on these sites, individuals with eating disorders create a much larger peer group than before, making dangerous eating disorders seem normal. This is a worrisome trend.

Families are also a major influence on individuals with eating disorders. They often compliment anorexic girls for being slim and praise their self-control. This serves as a source of reinforcement for the eating disorder

(Branch & Eurman, 1980). Bulimic patients reported that their families were competitive, prone to jealousy, and tended to intrude in each other's lives (Rorty et al., 2000). Importantly, adolescent girls whose families allow them to have some autonomy (i.e., control over their own lives) tend to have lower rates of eating disorders, suggesting that control is a major factor in these conditions (Polivy & Herman, 2002).

So, how do stress, peer pressure, and family issues lead to eating disorders? Researchers suggest that some people use eating disorders as a coping mechanism to deal with their difficult-to-control lives (Troop, 1998). By making weight and eating the primary focus of their lives, individuals gain some feelings of security (both physical and emotional) as well as a feeling of being in control of some aspect of their life. Indeed, after binging in the laboratory, individuals with bulimia reported feeling less anxiety, tension, and guilt, although feelings of depression remained the same (Kaye et al., 1986). In contrast, when these feelings of control are reduced, studies have shown that individuals with eating disorders become more pessimistic and report feeling fatter than before (Waller & Hodgson, 1996).

Evolutionary psychologists have suggested that this need for control extends to the woman's reproductive system as well. The *reproduction suppression hypothesis* states that females who believe they have low levels of social support from romantic partners and family members are more likely to engage in dieting behaviour (Juda et al., 2004). This change in food intake can influence ovulation (Frisch & Barbieri, 2002) and lead to a loss of menstrual periods (amenorrhea), making it less likely that the woman will become pregnant. Such data again suggest that eating disorders are an attempt to gain control over complex and stressful lives (Wasser & Barash, 1983).

People with anorexia experience severely distorted views of their body. Although dangerously underweight, they continue to both feel fat and fear being fat. Both males and females may become anorexic.

Ken McKay/Shutterstock

Males, although less prone to these problems than females, also develop eating disorders. Adolescents and young men may starve themselves during periods of high exercise to lose weight and achieve muscle mass (Ricciardelli & McCabe, 2004). Ironically, although they have positive views of their own bodies, these men with “reverse anorexia” are just as

obsessive and perfectionistic about their bodies as people with anorexia (Davis & Scott-Robertson, 2000). And both groups are particularly sensitive to media depictions of “perfect bodies” that, for almost everybody, are unattainable.

Working the Scientific Literacy Model

The Effect of Media Depictions of Beauty on Body Image

Listen to the Audio

One concern regarding eating disorders is the role that culture and the media play in their onset. Specifically, people with regular exposure to Western culture are more likely to develop bulimia than members of cultures without such exposure (Keel & Klump, 2003).

What do we know about the effect of media depictions of beauty on body image?

We often don't critically analyze the effects that media depictions of beauty can have on people, particularly on sensitive teenagers. In the 1950s, Marilyn Monroe—who was busty and had big hips—was considered gorgeous. Today, A-list actresses are pressured to have body shapes that are virtually impossible to achieve: a very thin body and large breasts. Failure to meet this standard will lead to mockery in magazines and on gossip websites. The result is that people who are not unnaturally thin may view their bodies as being ugly. But do these media depictions of "perfection" influence how girls and women view themselves?

How can science explain the effect of the media on people's body image?

The average North American woman is 163 cm (5′9″) and weighs 64 kg (140 lb); the average model is 180 cm (5′11″) and weighs 53 kg (117 lb) (National [U.S.] Eating Disorders Association, 2002). Studies have shown that increased exposure to media (TV, magazines, internet) is related to decreased satisfaction with a person's body (Hofschire & Greenberg, 2002), particularly in people whose self-esteem is based on meeting socially defined standards (Williams et al., 2014). It is also related to a greater internalization of the slender ideal for female body shape (Stice & Shaw, 1994). Researchers at Wilfrid Laurier University found that females were more likely to compare themselves to unrealistic popular culture figures than were men when they were describing their own bodies; they did not do so when describing their social skills (Strahan et al., 2006). When the prominence of cultural norms was increased, all participants (female and male) were more likely to compare themselves with a model and felt worse after doing so. These results suggest that women are more consistently exposed to media depictions of "perfect bodies," but that men are also sensitive to these pressures. In a follow-up study, female participants were exposed either to commercials containing attractive and thin women or to neutral stimuli. The results indicated that viewing media depictions of beauty decreased women's satisfaction with their own bodies and made them more concerned with what other people thought of them (Strahan et al., 2008).

Can we critically evaluate this research?

It is easy to say that participants in psychology studies are simply answering the way they think the experimenter wants them to. However, the studies just described are consistent with brain imaging data as well (Donnelly et al., 2018). Individuals with anorexia showed increased activity in the amygdala, a brain area

related to fear and emotional arousal, when they were shown negative words related to body image; neutral words did not have this effect (Miyake et al., 2010). Women with bulimia had greater levels of activity in medial frontal lobe regions related to emotional processing during the viewing of overweight as opposed to thin bodies; non-bulimic women did not show this activity. Finally, when women with eating disorders were shown images comparing themselves to idealized (model) bodies, the insula—a brain region related to disgust—fired (Friederich et al., 2010). Together, these studies corroborate the questionnaire-based results that idealized media depictions of beauty have negative emotional consequences on vulnerable individuals.

Why is this relevant?

Understanding the relationship between the media and disorders of body image allows teachers, parents, and healthcare practitioners to design programs to help image-conscious individuals. In Canada, several programs are now in place that aim to teach people how to deal with social pressures and to have a realistic body image (McVey et al., 2009; Yuile & McVey, 2009). Importantly, knowledge about media influences can reduce its effects. When public school students completed activities that contested the idea that women needed to be thin and beautiful and men needed to be tall and muscular in order to succeed, the influence of media depictions decreased substantially (Strahan et al., 2008). Not everyone needs to keep up with the Kardashians.

Module 11.1 Summary

Listen to the Audio

11.1a Know . . . the key terminology of motivation and hunger.

Review Module 11.1

Start Over Swap

0/12 REVIEWED · 0 MASTERED

motivation

Previous Next Got It!

11.1b Understand . . . the biological, cognitive, and social processes that shape eating patterns.

Energy is delivered through the bloodstream in the form of glucose found in food. The hormone insulin helps the cells throughout the body store

this fuel. CCK signals fullness (satiety). These substances are monitored by the hypothalamus, which signals hunger when not enough glucose is available to the cells. You should also have an understanding of the effects of psychological cues, such as the unit bias, as well as social cues, such as the minimal eating norm.

11.1c Understand . . . the causes of common eating disorders.

This module discussed issues related to anorexia and bulimia, both of which involve periods of self-starvation and a fear of gaining weight. Bulimia also includes purging, such as through vomiting or the use of laxatives. Stress, peer pressure, and idealized depictions of beauty all influence the prevalence of eating disorders. It is likely that many people with eating disorders are attempting to establish a feeling of control over some aspect(s) of their lives.

11.1d Apply . . . your knowledge of hunger regulation to better understand and evaluate your own eating patterns.

Do you finish an entire package of a food item, as the minimal eating norm would suggest? Or do you check to ensure you are getting an appropriate serving size? Try this activity to find out exactly how you eat.

Apply Activity

Starting first thing tomorrow, keep a food diary for the next three days. Record everything you eat over this period, including when you ate, what you ate, and what made you feel like eating. It is important to be honest with yourself and to be reflective: Did you eat because your stomach rumbled, because you were craving something, or perhaps because the food was just there? It is okay to list more than one reason for each entry in your food diary. At the end of the three-day period, tally how often each reason for eating appeared in your diary. Make note of what

proportion of the time you ate for each reason. Ask yourself: Are the results surprising? Do they make you want to think more about the reasons you eat? (Note: You can also try to work from memory and recreate a food diary from the past three or four days, but the results might not be as accurate.)

11.1e Analyze . . . the role of the media on people's body image.

A number of studies using a variety of methodologies—questionnaires and brain scanning—have shown that the media's idealized depictions of beauty have a negative influence on people's body image (and happiness). With this knowledge, you should be able to identify these misrepresentations of what a normal body should look like, to recognize that the motivation to eat is important, and to see that beauty is not necessarily Size 2.

Module 11.2 Sex

Listen to the Audio

PCHT/Shutterstock

Learning Objectives

11.2a Know. . . the key terminology associated with sexual motivation.

11.2b Understand . . . similarities and differences in sexual responses in men and women.

11.2c Apply . . . your understanding of sex and technology to examine your attitudes toward different forms of digital and online sexual activity.

11.2d Analyze . . . different explanations for what determines sexual orientation.

Calvin Coolidge was President of the United States from 1923 to 1929. He was known as a quiet man ("Silent Cal") who had a very dry sense of humour. However, even shy and reserved politicians need to attend social functions and meet constituents. On one of these occasions, President Coolidge and his wife were given separate tours of an experimental government farm. During her tour, Mrs. Coolidge noticed that a particular rooster was mating quite frequently. When she asked the farmer about this, he stated that the rooster mated dozens of times each day. Mrs. Coolidge then replied, "Tell that to the President when he comes by." When told this, President Coolidge asked if the rooster was mating with the same hen each time. The farmer replied that the rooster was mating with a number of different hens. President Coolidge then said, "Tell that to Mrs. Coolidge." Based upon this story, the tendency for males to show renewed sexual interest when a new female becomes available is now known as the ***Coolidge Effect****.*

Of course, novelty is only one reason why individuals would engage in sexual behaviour. In this module, we will examine evolutionary, psychological, physiological, and sociocultural factors that influence our motivation for sex.

Imagine seeing an attractive person walking along the beach, a toned body glistening in the hot summer sun. Then you and the object of your desire make eye contact and it is clear that the interest is mutual. Your initial response might seem like a white-hot biological drive. This is your **libido**—*the motivation for sexual activity and pleasure*. But whether you immediately act on this motivation is dependent upon a number of factors, not just "hotness." As researchers delve into the complex topic of sexual behaviour, it is becoming increasingly clear that our motivations are shaped by evolutionary, physiological, psychological, and social factors, and that these factors interact with each other differently in different people.

Human Sexual Behaviour: Evolutionary Influences

Listen to the Audio

One of the primary goals of most organisms is to pass on their genetic material to the next generation—in other words, to breed. In many species, including humans, this is accomplished through sex. The big question, then, is what factors influence whether an individual gets to act on this motivation for sex? According to the theory of natural selection (see Module 3.1), individuals with traits that are are a good fit for their environment are more likely to survive and therefore to reproduce. The question is, how do these individuals let others know that they possess these traits?

Sexual Selection and Evolution

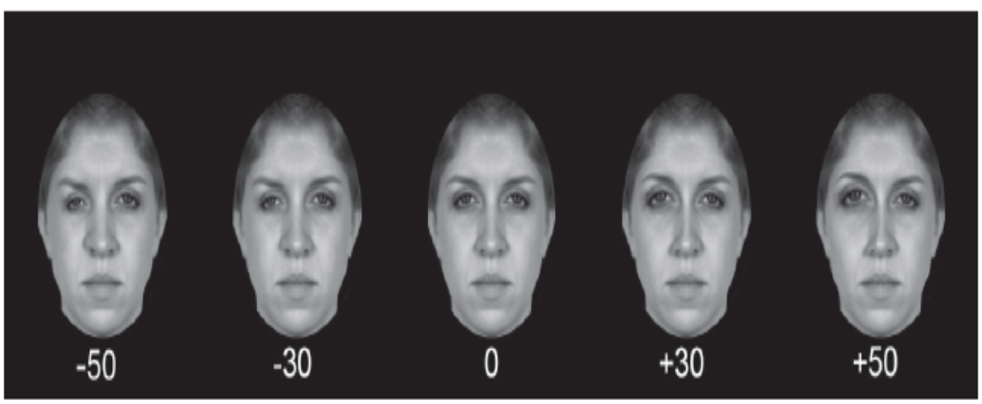
Listen to the Audio

In some species, members of one sex (usually males) compete for access to the other sex (usually females). For instance, some animals, deer and caribou for example, literally lock horns in violent fights known as *rutting*. The winner of the fight is much more likely to mate with females than is the loser. Similar examples occur in many primate species. Here, a dominant male—often referred to as the *alpha male*—intimidates other males and is more likely to mate with multiple females than are the subordinate males. These are examples of **intrasexual selection**, *a situation in which members of the same sex compete in order to win the opportunity to mate with members of the opposite sex*. Intrasexual selection is evolutionarily advantageous because the animals most likely to become dominant are the strongest and/or smartest, and therefore the most fit for that time and place. If this trend continues across many generations, the species as a whole will become stronger and smarter (i.e., more evolutionarily "fit").

A second form of sexual selection is known as **intersexual selection**, *a situation in which members of one sex select a mating partner based on their desirable traits*. In the animal kingdom, we see numerous examples of males attempting to attract the attention of females. For instance, many male birds display bright feathers and perform intricate dances or songs to attract females. This might seem cute, but this has a darker function as well. Brightly coloured birds must be fast and aware of their surroundings (i.e., evolutionarily fit). Otherwise, that glorious plumage, which also

attracts predators, would turn them into someone's lunch rather than into someone's mate. Therefore, the brightly coloured birds that *do* survive must have physical and mental characteristics that should be passed on to future generations.

Humans also have characteristics that enhance mating success. On average, heterosexual women prefer men who are taller (1.83 m or 6′0), with good posture, and who are not very hairy (Buss, 2003; Dixson et al., 2010). Heterosexual men prefer women who are slightly shorter than them, have full lips, high cheekbones, and a small chin. A number of experiments have shown that people rate symmetrical faces as being more attractive than asymmetrical faces (Gangestad et al., 1994; Rhodes, 2006). Overall, people tend to prefer partners who appear healthy. An evolutionary psychologist would suggest that such individuals would also be more likely to be fertile and to possess good genes.



Facial Symmetry and Attraction Which face do you prefer of these five? You likely chose the middle face because it has the highest level of symmetry. People can detect this quality without even having to study the faces very closely.

The University of Western Australia

Importantly, not all elements of intersexual selection are the gift (or curse) of our genes. Men often present cues that highlight their

masculinity, such as wearing clothes that display their muscles. They also attempt to appear large and athletic, particularly when around potential mates. For example, if an attractive woman walks by a group of men, they tend to stand up straight to appear taller and healthier, and thus more attractive (this makes for wonderful people-watching at bars). Evolutionary psychologists suggest that this behaviour is an attempt to appear more genetically fit than their competitors; doing so would suggest to potential mates that their offspring would be similarly fit. Women also attempt to highlight attractive elements of their physique with body posture and clothing. Of course, there are other qualities we look for in a potential partner, particularly when it comes to long-term mates.

Parental Investment and Sexual Selection

Listen to the Audio

In the late 1980s, David Buss, a researcher at the University of Texas at Austin, conducted a survey of more than 10 000 people from 37 different cultures to discover what they most valued in a long-term partner (Buss, 1989). Across this broad sample, both men and women agreed that love, kindness, commitment, character, and emotional maturity were important. However, there were some interesting differences. Women valued men with strong financial prospects, status, and good health; whereas men placed a greater emphasis on physical beauty, youth, and other characteristics that relate to reproduction.

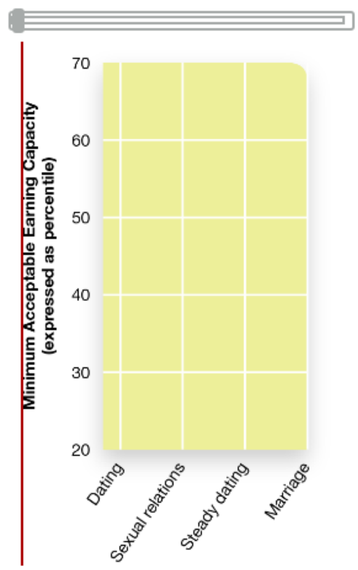
Other investigators have found similar sex differences (see Figure 11.5). Researchers in the United States showed yearbook photographs to heterosexual male and female research participants. Along with the photographs, participants were provided with information about each individual's socioeconomic status (SES), a measure of their financial status. SES had a much greater effect on females' willingness to enter relationships with these individuals than it did for males (Townsend & Levy, 1990b). In a subsequent study, these researchers controlled for differences in physical features by photographing models three times each, with these pictures differing only by clothing. Thus, participants could see a single model in an outfit that implied high, medium, or low SES. Participants were asked to rate their willingness to engage in different types of relationships with this person, ranging from "Coffee and conversation" to "Sex only" to "Marriage." Clothing, the indicator of SES,

had a much larger effect on females than males, particularly when the model was not physically attractive. Men were much more willing to engage in "Sex only" relationships regardless of SES or attractiveness (Townsend & Levy, 1990a).

Figure 11.5

Sex Differences in the Minimum Accepted Earning Level of Different Types of Relationships

Use the slider to reveal the data.



Females place a much higher value on economic stability than do males, particularly for long-term relationships. This result may be due to the fact that females can produce a limited number of offspring and therefore need to ensure that a mater has enough resources to ensure their survival. Evolutionary psychology is not necessarily romantic.

Source: From Kenrik, D.T., Sadalla, E.K., Groth, G., & Torst, M.R. Evolution, traits and the stages of human courtship: Qualifying the parental investment model. *Journal of Personality*, 58, 97-11. © 1990 John Wiley & Sons, Inc. Reproduced with permission of John Wiley & Sons.

How can we explain this difference? According to evolutionary psychologists, this difference might be due to the resources required to raise offspring. Females have a limited number of eggs, and thus a finite

number of opportunities to pass on their genes to another generation. If a female became pregnant and had a baby, she would require resources to help raise the child, particularly when the child is quite young and it is difficult for the woman to bring in her own resources. Therefore, it would make sense that females would be attracted to males who can provide these resources; this sometimes means mating with someone who is older and more established in life (Trivers, 1972). In contrast, men have a seemingly infinite amount of sperm and have fewer limits on the number of people they could theoretically impregnate. Given that their evolutionary impulse is to pass on their genes to as many offspring as possible, it makes sense for them to be attracted to young, healthy women who are likely able to reproduce (Buss, 1989). Oddly, these motivations don't appear in many love songs.

Human Sexual Behaviour: Psychological Influences

Listen to the Audio

Although its main evolutionary purpose is reproduction, sexual motivation is actually expressed in many different ways. Sexual themes are common in television, movies, video games, humour, advertising, and other media, and discussions of sex and sexuality influence social life, school, and the workplace. But it is also one of the most challenging topics to study. Sex generally happens in private, and many people prefer to keep it that way. Nonetheless, psychologists use a variety of methods to understand the complexities of human sexual behaviour. When attempting to examine attitudes and psychological motivations for sex, researchers tend to rely on nonintrusive techniques such as interviews and questionnaires.

Interview Assessments of Sexual Motivation

Listen to the Audio

One of the first scientists to tackle the topic of human sexual behaviour was zoology professor Alfred Kinsey. Kinsey began his research on human sexuality by interviewing his students about their sexual histories. Between 1938 and 1952, Kinsey and his colleagues at Indiana University interviewed thousands of people and published their results in a pair of books known informally as the Kinsey Reports (1948, 1953). By modern standards, Kinsey's methods were quite flawed and rather controversial. Kinsey tended to make sweeping generalizations about his findings that were based on very limited samples. Despite these practices, Kinsey's work on sexuality continues to influence discussion on sexual behaviour and motivation.

The fact that Kinsey dared to apply science to sexuality was offensive to many people at the time. During an era when the phrase sexual orientation did not even exist, Kinsey reported that 37% of the males whom he interviewed had at least one homosexual experience resulting in orgasm; this was absolutely shocking at the time. (The corresponding figure for females in his studies was 13%.) Contrary to the conventional thinking of his time, Kinsey believed that heterosexuality and homosexuality fell on a continuous scale, an idea that remains with us today.

Alfred Kinsey's research into sexual behaviours paved the way for future generations of scientists to study sexual motivation. Can you think of some modern research tools that weren't available during Kinsey's time?

AP/Shutterstock

Survey Studies of Sexual Motivation

Listen to the Audio

It is important to note that the methods for studying sexual behaviour have changed since Kinsey conducted his groundbreaking investigations. Extensive interviews have been largely replaced with anonymously completed questionnaires that encourage participants to provide more candid responses. Studies also include larger and more representative samples. For example, psychologists Cindy Meston and David Buss asked more than 1500 U.S. college students to identify their reasons for having sex. As you can see in Figure 11.6, physical, personal, and social factors underlie sexual motivation.

Figure 11.6 Why Have Sex?

Self-reported reasons for having sex by undergraduate students (Meston & Buss, 2007).

Anna Khomulo/Fotolia

For the respondents in Meston and Buss's study, physical reasons were related to the pleasure of the sex itself. Many respondents used sex for what might be described as instrumental reasons—sex was a means of accomplishing a goal such as financial or personal gain, or revenge. Students were also motivated by emotional reasons and because of feelings of insecurity (although there is little evidence to suggest that sex leads to any long-term improvements in this regard). Reproduction, the key evolutionary motivation for sex, ranked very far down the list.

Sexual motivation is also tied to relationship context. A study conducted at the University of Ottawa found that females are more motivated by physical pleasure when seeking out short-term relationships, but are motivated by emotional factors when seeking out long-term relationships (Armstrong & Reissing, 2015). This pattern occurred for women across the continuum of sexual orientation. You can evaluate your own attitudes about sex and compare them with others by completing the activity in Table 11.2.

Table 11.2 Attitudes toward Sex Survey

How do you feel about sexuality? You can apply what we have learned from research to understand if you take a generally permissive attitude (people have the right to do what they want) or a more conservative one. Respond to each of the items below by assigning a score on a scale from "strongly agree" (worth 1 point) to "strongly disagree" (worth 5 points). Note that it is not necessary to be sexually active to complete this scale—simply respond to the general principle of each item.

1. I do not need to be committed to a person to have sex with him or her.

- ○ Strongly Agree
- ○ Moderately Agree
- ○ Neither Agree nor Disagree
- ○ Moderately Disagree
- ○ Strongly Disagree

2. Casual sex is acceptable.

- ○ Strongly Agree
- ○ Moderately Agree
- ○ Neither Agree nor Disagree
- ○ Moderately Disagree
- ○ Strongly Disagree

Previous Next

Age is also a factor in sexual motivation. Although young people don't typically associate older individuals with sex (Thompson et al., 2014), survey studies show that almost three-fourths of the 57- to 64-year-old respondents reported sexual contact with a partner in the past year, as did half of the 64- to 75-year-olds and one-fourth of the 75- to 85-year-old respondents (Lindau et al., 2007). While these numbers aren't at the level of sexual activity of average university students, they do show that the

motivation to have sex continues throughout the lifetime. It is also worth noting that surveys indicate that the sexual motives of middle-aged women are the same as women aged 18 to 22 years: pleasure, love, and commitment (Meston et al., 2009).

The survey and interview methods discussed to this point have provided a rich set of data about human sexuality. Other researchers have approached this topic from a biological standpoint by looking at the physiological and brain basis of sexual motivation (Pfaus et al., 2012), a topic we will consider in the next section of this module.

Human Sexual Behaviour: Physiological Influences

Listen to the Audio

Our physiological and psychological motives for having sex are not separate. Sexual arousal (a biological state) can influence what we pay attention to and how we respond to it. In other words, it can influence our feelings of desire (Pfaus & Scepkowski, 2005). Although several decades of research have helped identify many of the biological processes associated with sexual motivation, it is important to remember that all of these physiological responses are influenced by a person's psychological state.

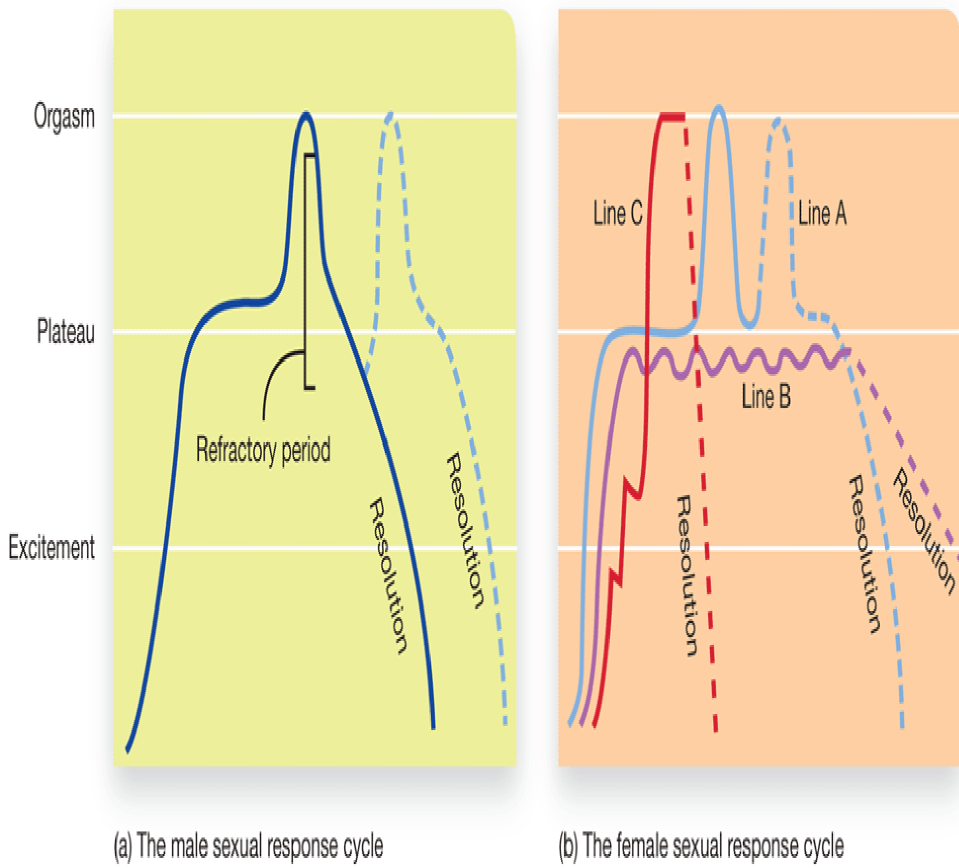
Physiological Measures of Sex

Listen to the Audio

William Masters and Virginia Johnson performed some of the earliest studies of sexual behaviour in the 1950s. These researchers described the human sexual response cycle based on their observations of 27 male and 118 female prostitutes who agreed to masturbate or to have intercourse while under observation (Masters & Johnson, 1966). Participants were monitored with heart rate and blood pressure equipment, as well as with more peculiar devices such as the penile plethysmograph or vaginal photoplethysmograph, which are designed to measure blood flow to the genitalia in men and women, respectively. Masters and Johnson's initial study allowed them to develop their methods and work with participants who, according to the researchers, were less likely to be sexually inhibited than non-prostitutes. Masters and Johnson followed up this study with observations of hundreds of men and women to characterize the physiological changes that occur during sex.

Figure 11.7 summarizes Masters and Johnson's (1966) observations of human sexual responding in males and females. The **sexual response cycle** *describes the phases of physiological change during sexual activity, which comprises four primary stages: excitement, plateau, orgasm, and resolution*. Dividing the sexual response cycle into phases allowed the researchers to describe the cascade of physiological changes that occur during sexual behaviour. The cycle applies to both male and female sexual responses, although there are differences between sexes in how these stages are experienced as well as their duration.

Figure 11.7 Sexual Response Cycles



(a) Masters and Johnson's studies showed that males typically experience a single orgasm followed by a refractory period—a time during which orgasm cannot be physically achieved again. Then they experience resolution, unless they continue sexual activity. (b) Women typically have a more varied sexual response profile than men. Here are a few examples: Line A indicates a woman who has multiple orgasms, Line B a woman who does not experience orgasm, and Line C a woman who has a single orgasm.

One topic of particular interest is how males and females differ in their patterns of orgasm. For example, in one study, 21% to 32% of women reported that they did not experience orgasm during masturbation or sexual intercourse (Dunn et al., 2005), whereas only 2% of men did not experience orgasm. Men usually experience a single orgasm followed by

a **refractory period**, *a time period during which erection and orgasm are not physically possible*. In contrast, some women experience multiple orgasms without a refractory period.

Recent brain imaging studies have shown that much of the sexual response cycle is influenced by the hypothalamus. In one stimulating study, researchers examined the brain activity of women when they experienced an orgasm while being monitored by functional MRIs (Komisaruk, 2005). Physical stimulation led to activity in the hypothalamus, which, in turn, stimulated the pituitary gland to release a hormone called **oxytocin**, *a hormone related to feelings of trust and the desire to be close to someone* (Aron et al., 2005; Zak, 2008). Blood levels of oxytocin surge just after orgasm and may remain elevated for at least five minutes in both females and males (Carmichael et al., 1994; Murphy et al., 1990). This hormonal response may promote bonding between sexual partners, as one of our fundamental motivations as humans is to feel connected to others (see Module 11.3).

Sexual Orientation: Biology and Environment

Listen to the Audio

Although the research discussed thus far has shed light on many aspects of sexual behaviour, there are still questions that have not been answered. A topic that has garnered considerable interest is **sexual orientation**, *the consistent preference for sexual relations with members of the opposite sex (heterosexuality), same sex (homosexuality), or either sex (bisexuality)*. Current definitions of sexual orientation focus on the psychological aspects of sexuality (e.g., desire, emotion, identification) rather than strictly behavioural criteria (Bailey et al., 2000). For example, a person can have a sexual orientation but never have sexual contact throughout his or her life.

There is a popular misconception that homosexual behaviour is "unnatural" and that it is only a human behaviour. However, as you will see in this section, there is a great deal of evidence showing that homosexuality is common in a number of species (Roselli et al., 2004), and likely has its roots in the developing brain.

Homosexuality in Nature

Some female koala bears have been observed rejecting advances of male koalas and opting for sexual interactions with females.

1 of 4

Previous

Next

Source: Julian W/Shutterstock; Natureguy/Fotolia; Elena Larina/Shutterstock; Sergey Uryadrikov/Shutterstock

Working the Scientific Literacy Model

Sexual Orientation and the Brain

Listen to the Audio

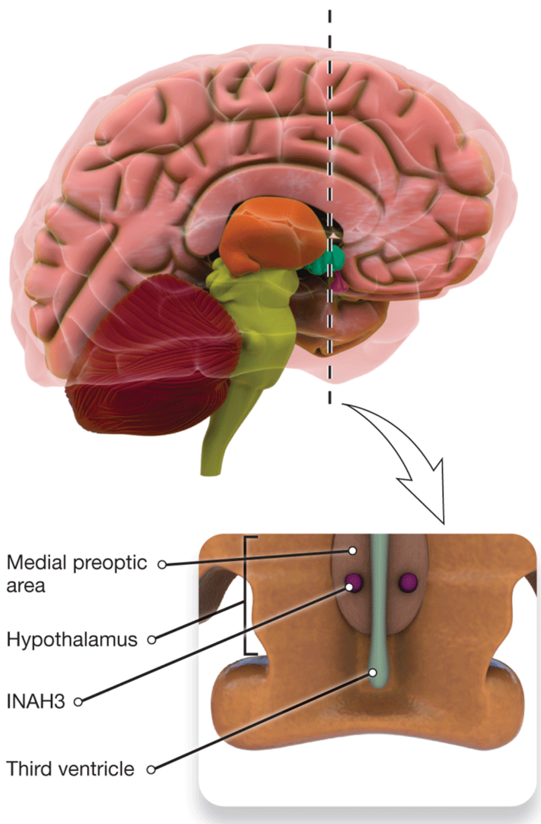
Homosexuality has not always been as widely accepted as it is today. Indeed, psychologists have long struggled to find a satisfactory explanation for variations in sexual orientation. Sigmund Freud (1905) advanced the theory that male homosexuality could be traced to the presence of a domineering mother and a weak father figure. As recently as 1987, Ellis and Ames argued that homosexuality could be caused by experiencing seduction from an older sibling or playmate. Both theories lack scientific evidence to confirm their validity. Modern researchers have begun to examine the degree to which sexual orientation is based on choices people make and on biologically related factors such as genetics or differences in brain anatomy.

What do we know about the sexual orientation and the brain?

In the early 1990s, neuroscientist Simon LeVay compared the brains of deceased homosexual and heterosexual males. In his work, he found that an area of the hypothalamus was, on average, smaller in gay men compared to heterosexual men (Figure 11.8; LeVay, 1991). LeVay's results created a storm of controversy among both scientists and the public. Many people interpreted his findings as proof that homosexuality was biologically, and therefore genetically, determined. In fact, the

differences in the hypothalamus could have been due to environmental factors—LeVay's study was not designed to test either conclusion.

Figure 11.8 Sexual Orientation and the Brain



An early study of the brain basis of sexual orientation found that homosexual males had a smaller subregion (INAH3) of the hypothalamus within the medial pre-optic area (LeVay, 1991).

Scientists have been skeptical of LeVay's results, in part because they have proved difficult to replicate (Lasco et al., 2002). The region of the hypothalamus he identified was only smaller *on average* in gay men versus heterosexual men, and the ranges in size were overlapping, with some gay men having a larger hypothalamic region than some heterosexual men. In addition, the purportedly homosexual men whom LeVay studied died of

complications associated with HIV, which could have accounted for the differences in their brains. Although its results are not considered definitive, LeVay's study stimulated considerable scientific curiosity and debate about links between the brain and sexual orientation.

How can science explain the relationship between sexual orientation and the brain?

A key element of the biology of sexual orientation is the role of **testosterone**, *a hormone that is involved in the development of sex characteristics and the motivation for sexual behaviour* (see Module 3.1 for a discussion of testosterone's role in aggression). Greater prenatal exposure to testosterone causes male-typical brain development and partner preferences (i.e., a preference for females). Lower levels of prenatal testosterone lead to female-typical brain development and partner preferences (i.e., a preference for males). In studies with nonhuman animals, researchers have found that exposing a fetus to high levels of testosterone led to a preference for female sexual partners later in life, whereas low testosterone exposure led to a preference for male partners (Henley et al., 2011). It is clear that the presence of testosterone influences the development of several brain structures (Manzouri & Savic, 2018a), many of which are likely related to sexual orientation (Roselli, 2017).

Brain imaging studies have found that differences between heterosexual and homosexual individuals exist in some neural areas that are *sexually dimorphic* (i.e., that vary between the sexes). These areas include the anterior cingulate gyrus (the part of the brain that is on top of the corpus callosum) and the hypothalamus. There is also evidence that the hypothalamus is part of different brain networks in homosexual and heterosexual males (Manzouri & Savic, 2018b). Other research has shown that

differences in sexual orientation are associated with the size of the amygdalae (structures related to emotional responses; Savic & Lindström, 2008) and also the thickness of several regions of the cortex (Abé et al., 2014).

Together, these studies show that hormones such as testosterone can affect how parts of the brain develop, and that these brain areas show slight differences in their size and functioning in homosexual and heterosexual individuals.

Can we critically evaluate this research?

One potential criticism of these studies is that it is unclear whether the brain differences that were identified would actually lead to differences in *behaviour*. In other words, are the differences in the hypothalamus and other midline brain structures related to differences in how heterosexual and homosexual individuals respond to different stimuli? Techniques such as functional MRI can be used to address this concern. In one study, homosexual men and heterosexual women showed greater activation in the medial preoptic area of the hypothalamus while smelling a male derivative of testosterone found in sweat. This brain region did not become activated when heterosexual men smelled male sweat (Savic et al., 2005). Homosexual males and heterosexual females also showed greater activity in the brain's reward centres when viewing pictures of aroused male genitalia. Similar results were found when homosexual and heterosexual men and women viewed erotic images, with the images of the preferred sex leading to greater activity in many midline brain structures, particularly in male participants (Poeppl et al., 2016; Sylva et al., 2013). (Interestingly, bisexual individuals tend to show similar responses to male and female images; Safron et al., 2017). These findings might not provide the final answer about the neural basis of sexual

orientation, but they do indicate that differences in sexual motivation are related to differences in patterns of brain activity.

An additional concern regarding the brain-anatomy data is that many animals have brain structures that are similar to ours. If this is the case, then wouldn't homosexuality exist in nonhuman species? Biologists have found that this is in fact that case, with approximately 8% to 10% of many species engaging in same-sex encounters. Notably, the primary brain difference detected in many of these studies is that homosexual animals had a smaller hypothalamus (Roselli et al., 2004).

Why is this relevant?

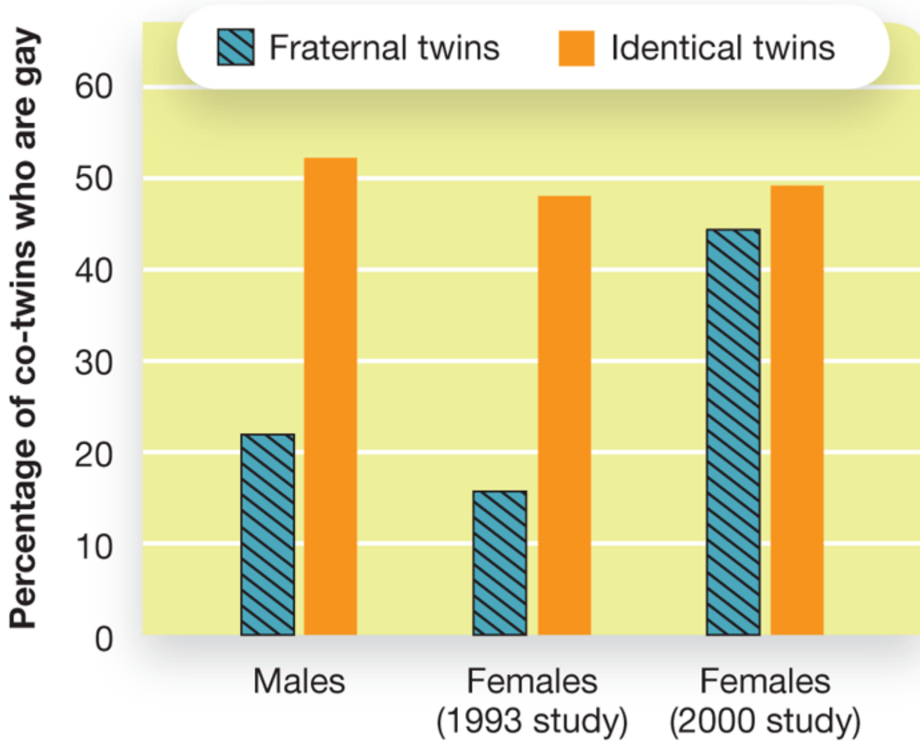
Understanding that sexual orientation has a biological origin has important social implications. It demonstrates that sexual orientation isn't simply a lifestyle choice that can be changed like a job or wardrobe. Instead, the brain areas related to sexual preference are evolutionarily ancient structures found across a number of species (Poeppl et al., 2016). This information should also help discredit a controversial practice known as *conversion therapy*, in which "therapists" attempt to teach homosexual or bisexual individuals to become heterosexual. Elements of this pseudoscientific therapy include pairing homoerotic images with painful shocks and telling the individuals that their sexual orientation is a moral failing (Haldeman, 2002). Although this cruel practice is opposed by all major psychological and psychiatric organizations, it is still promoted by some religious organizations and politicians in North America. Hopefully additional scientific information will lead to the banning of this practice.

Genetics and Sexual Orientation

Listen to the Audio

Other research suggests that sexual orientation may be influenced by a combination of genes. Evidence for this comes from twin studies that have examined whether identical twins are more likely to have the same sexual orientation than are fraternal twins. Genetic correlations between 0.30 and 0.60 for homosexuality have been reported for both men and women, suggesting that approximately half of the individual differences found in sexual orientation are due to genetic factors (Figure 11.9; Bailey & Pillard, 1995; Bailey et al., 1993; Kirk et al., 2000). This result tends to hold true for gay men across multiple studies. In contrast, studies have failed to confirm a genetic relationship between genes and homosexuality in women (Bailey et al., 2000; Långström et al., 2010). Thus, genes appear to play at least some role in sexual orientation, particularly for men. However, this statement does not mean that sexual orientation is *determined* by genetics. The brain and endocrine system are remarkably sensitive to the environment, and they interact with a variety of sociocultural factors (Meston & Ahrold, 2010). More research investigating these interactions is clearly necessary.

Figure 11.9 Genetics and Sexual Orientation



Twin studies tend to show consistently higher genetic correlations for sexual orientation between male identical twins compared to fraternal twins. This finding indicates that male homosexuality has a genetic basis. Results of studies comparing female identical and fraternal twins are not as consistent.

Sources: Based on data from Bailey & Pillard (1995), Bailey et al. (1993), and Bailey et al. (2000).

Transgender and Transsexual Individuals

Listen to the Audio

Most Canadian universities have an office or organization dedicated to supporting lesbian, gay, bisexual, and transgender (LGBT) individuals, doing their utmost to provide them with emotional, social, and sometimes legal assistance. Thus far, we have discussed many issues related to sexual orientation, the "LGB" in the above acronym. Until recently, relatively little was known about transgender individuals. However, with an increasing number of celebrities going public with their "trans" status, this topic has been brought to the forefront of popular culture.

The term **transgender** refers to *individuals who experience a mismatch between the gender that they identify with and their biological sex* (Oliven, 1965). It does *not* refer to an individual's sexual orientation. **Transsexual**, on the other hand, *refers to the subset of transgender individuals who wish to permanently transition from their birth sex to the gender with which they identify* (Bevan, 2014). Many transsexual individuals seek medical assistance in the form of sexual reassignment surgery.

In the past ten years, researchers have begun to investigate whether there are brain-based differences between transgender individuals and the rest of the population (Kreukels & Guillamon, 2016). They suggest that sex hormones such as testosterone influence the sex differentiation of the genitals in the first 6 to 12 weeks of prenatal development. Sexual differentiation of brain structures (i.e., the differences that exist between

male and female brains) begin to occur in the second half of prenatal development. In transgender individuals, it is possible that sex hormones caused the genitals and body to develop in the direction of one sex (e.g., male), while the brain and gender developed in the opposite direction (e.g., female; Swaab & Garcia-Falgueras, 2009). Consistent with this view, researchers have found that the volume of some nuclei in the hypothalamus of male-to-female (MtF) transsexuals resembled female rather than male brains (Garcia-Falgueras & Swaab, 2008). Researchers have also found that the brains of females transitioning to males (FtM) and males transitioning to females (MtF) differ from each other, with MtF individuals having more white-matter connections between subcortical areas (lower in the brain) than FtM individuals (Hahn et al., 2015). Of course, as this line of research is still in its early stages, we must be cautious when drawing conclusions.

Laverne Cox, an American actress from the Netflix series *Orange Is the New Black*, was the first openly transgender person to be nominated for an Emmy Award. Cox, an LGBTQ activist, has helped shine a spotlight on many issues related to how people in the LGBTQ communities are treated in society.

A katz/Shutterstock

It is important to note that this research was not making any moral judgments about anyone—it was simply an investigation into differences between groups of people. That said, transgender and transsexual individuals *do* face many struggles in our society, and experience stress and discrimination that can affect health care and their general well-being (Dargie et al., 2014; Hughto et al., 2015). In an effort to counter these negative effects, organizations such as the Canadian Psychological Association (CPA) have produced literature aimed at helping transgender individuals deal with their negative emotions (CPA, 2016). This information is also useful for educators, as it will allow them to help adolescents who are experiencing gender uncertainty, and to provide accurate information to other students receiving education about sex ("sex ed").

Psych@

Sex Ed

In 2015, the Government of Ontario introduced a new sexual education curriculum that attracted national attention. In addition to learning the names and functions of the parts of the male and female reproductive systems, students would learn about sexting, consent, contraception, sexual orientation, and gender identity. As noted earlier in this module, some of these topics—particularly gender identity and sexual orientation—have been associated with ill-informed explanations. The goal of the sexual education program was to provide students with scientifically accurate information. Although the majority of parents supported the updating of the curriculum, a very vocal

minority opposed the teaching of topics related to homosexuality, abortion, and contraception.

In 2018, the Liberal government of Kathleen Wynne was replaced by Doug Ford's Conservative Party. One of Ford's election promises was to scrap the new sexual education curriculum, a promise that he kept. The replacement curriculum does not include information about consent or masturbation, and contains less descriptive information about online sexual predators. It also provides almost no information about gender identity and transgender issues (Hauen, 2018). The contrast in the Liberal and Conservative "sex ed" curricula leads to some very important questions about sexual education. What topics should be included? And do students benefit from this information?

One thing that most researchers agree upon is that programs that focus on abstinence (i.e., not having sex) are not effective. A study of the abstinence-until-marriage sex-ed programs used in many conservative U.S. states found that they did not affect when teens became sexually active (Santelli et al., 2017). Additionally, many of the students left these programs with medically inaccurate information and stigmas about sex. A large-scale interview study in the U.K. suggested that sex education should be integrated into larger school programs that promoted positive and respectful interactions in general (Pound et al., 2017). Topics such as consent and accepting different gender identities would naturally fall into this respect-based program. Students have also noted that sexual information should be taught in a relevant and engaging manner (Byers et al., 2013) and that the emphasis should include *some* sex-positive information rather than the focus being entirely on the dangers of sex (Pound et al., 2017).

It is hoped that politicians (regardless of their political party) will examine some of the available research on sex education in order to provide students with accurate information. After all, sex education curricula *should* ensure that students will leave middle school and high school with a decent understanding of sex. This will help teens make informed decisions about the very adult issues they will soon face.

Human Sexual Behaviour: Cultural Influences

Listen to the Audio

How is an 18-year-old woman "supposed to" act when she is interested in having sex? How about an 18-year-old man? Although we'd all love to say that people should act any way they want, **gender roles**, *the accepted attitudes and behaviours of males and females in a given society*, exist. These gender roles are flexible over time, however. Your great-grandmothers were unlikely to have worn revealing clothing or have "hook ups" or "friends with benefits"; this norm has changed across generations. Indeed, across generations, there have been significant changes in male and female **sexual scripts**, *the set of rules and assumptions about the sexual behaviours of males and females*.

Social Changes and Sexual Behaviour

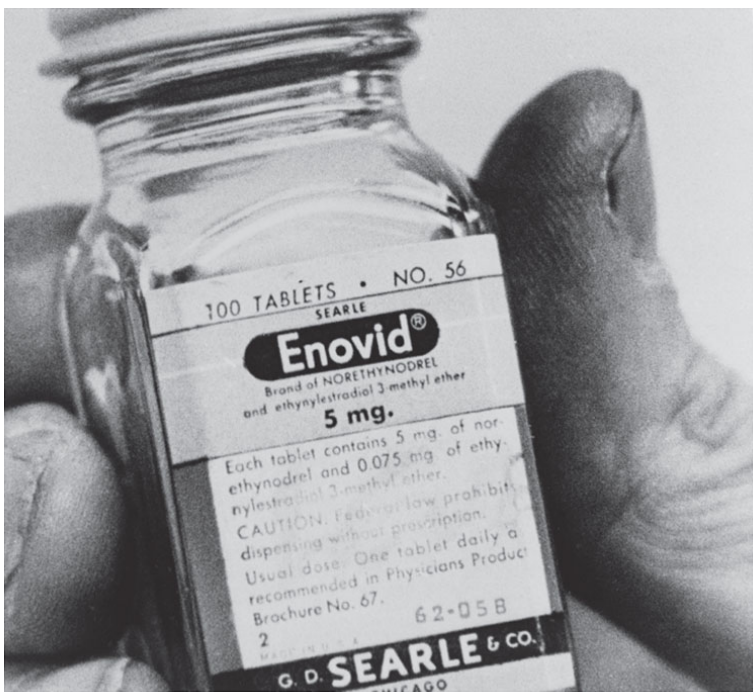
Listen to the Audio

For most of human history, male sexual behaviour was based on competition. Men would value sexual conquests and the physical attractiveness of females. Females, on the other hand, would be taught to be less promiscuous and to focus on developing a stable relationship before engaging in sexual intercourse. These roles are consistent with the evolutionary explanations for sex discussed earlier in this module.

But this evolutionary explanation is only part of the explanation for gender roles and sexual scripts. For a large part of human history, societies were set up in a way that gave men greater power than women. Indeed, in many cultures, women were viewed as possessions—first of their fathers and then of their husbands. Restricting the sexual expressiveness of women limited their ability to feel empowered, and allowed the "status quo" of the patriarchy (male-dominated society) to continue.

But, as we noted, these scripts are changing. Why do you think that is? Although there are dozens of potential explanations, there are three that are particularly important. The first is the emergence of the women's rights movement over the past 130 years. This movement challenged the core values of patriarchal society and put pressure on lawmakers to allow women to have equal economic and political rights, such as voting. The result was that women were perceived as people rather than possessions. A second, related, cause was the increasing presence of women in the

workforce. This economic independence meant that females could take care of themselves if they became pregnant. Therefore, they didn't need to be as careful about whom they had sex with. The third reason for changing sexual scripts was "the pill." The U.S. Federal Drug Administration approved the drug Enovid for use as a contraceptive on June 23, 1960 (Marks, 2001); the pill was legalized in Canada in 1969. This shift allowed women to have control over when they were going to become pregnant, thus giving them much more control over their sexual behaviours. The importance of contraceptives cannot be overstated. Imagine how people's lives would be changed if pregnancy was a strong possibility every time someone had sex.



The development of birth control pills allowed women greater control over whether they would become pregnant, and dramatically changed our society.

Everett Collection Historical/Alamy Stock Photo

Cultural Differences and Sexual Behaviour

Listen to the Audio

Of course, it is important to note that not all females or males follow the same sexual scripts. Different ethnicities and religious groups have their own scripts as well. For instance, researchers at the University of British Columbia found that Chinese women (born in China or Taiwan, but living in Canada) reported more conservative sexual attitudes (Woo et al., 2010) and lower levels of sexual desire than Euro-Canadian women (Woo et al., 2012). Why would this occur? Researchers have found that **sex guilt**, *negative emotional feelings for having violated culturally accepted standards of appropriate sexual behaviour*, is a major factor in these differences. Interestingly, these differences decrease for individuals who become more involved with mainstream Western culture, suggesting that a number of social and cultural factors influence sexual motivations (Brotto et al., 2005).

Sexual scripts also exist in homosexual relationships. Indeed, researchers in this field have highlighted the butch (traditionally masculine) and femme (traditionally feminine) gender roles of some lesbians (Blair & Hoskin, 2016; Munt, 1998). However, research suggests that these sexual scripts are more flexible than in heterosexual relationships, possibly due to the fact that many homosexual individuals do not follow gender roles to the same degree as do heterosexual individuals (Kurdek, 2005).

Sex and Technology

Listen to the Audio

What type of sexual scripts would develop if people could engage in sexual behaviour anonymously without having to physically interact with another person? Although your grandparents may have considered that question to be science fiction pornography, in the past two decades electronic media such as text messaging, instant messaging, and social networking sites *have* become common outlets for sexual expression. Electronic media are often used for viewing pornography, having online sexual encounters, and meeting others for sex offline (i.e., in the real world). Adolescents, as well as both single and married adults, engage in *cybersex*—that is, the use of the internet and cell phones for sending sexually explicit images and messages to a partner. An estimated 76.5% of university students use the internet for some form of sexual entertainment (Döring et al., 2017). Many of these experiences tend to occur with a person's primary sexual partner, although interactions do occur with known non-partners and with strangers (Shaughnessy et al., 2014).

Unplanned pregnancy and STDs are obviously not an immediate risk of cybersex. However, people tend to communicate with less inhibition via digital media compared to face-to-face encounters. This opens up the possibility for impulsive behaviour such as sending sexually explicit pictures and messages ("sexting"). These images could end up being shared with individuals who were not the intended viewer. Many teens have suffered rather harsh legal consequences for sexting. Some U.S.

states consider sexting to be a form of underage pornography and those convicted could be required to register as sex offenders. The Supreme Court of Canada has indicated that underage teens can possess sexual images of each other assuming it is consensual; however, the distribution of such images is illegal (*R. v. Sharpe*; Supreme Court of Canada, 2001).

Regardless of your opinion of, or experience with, cybersex, it is impossible to ignore the fact that sexual material is readily available in the wired world. Indeed, some of the most popular websites in the world contain sexually explicit material.

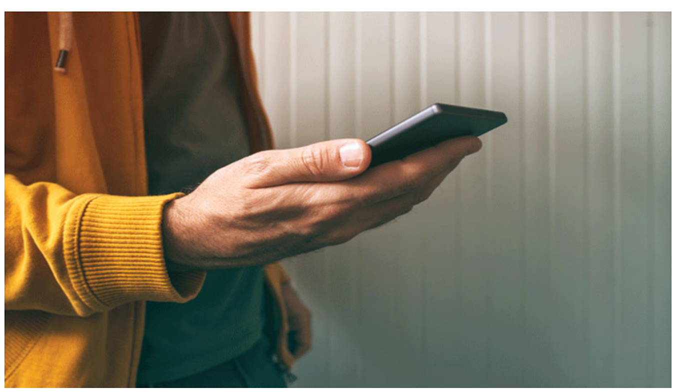
#Psych

Internet Pornography

In the 1970s, people interested in viewing sexually explicit materials had to buy a magazine such as *Playboy* or go to a theatre showing a pornographic movie. Now, with the advent of internet pornography, these obstacles are no longer an issue. Indeed, for the past several years, Montreal-based Pornhub.com has been among the most popular websites in Canada, generally ranking in the top 10 in site visits. The growing popularity of internet porn is based on the Triple-A concept: it is easily accessible, it is affordable, and it is generally anonymous (Cooper, 1998). It is also biologically rewarding. An fMRI study of healthy male participants found that brief displays of erotic videos elicited activity in the brain's reward network (Kühn, & Gallinat, 2014). Survey and behavioural studies of female heterosexuals and homosexual males also suggest that these stimuli can be rewarding (Laier et al., 2014, 2015). However, the research is not entirely positive. Internet

pornography can become addictive (Love et al., 2015). Additionally, frequent viewers can develop a tolerance to pornography. These individuals need a greater amount of visual stimulation in order to elicit the same reward response in the brain as moderate users (Kühn & Gallinat, 2014). Despite habituating to sexual imagery, viewers are not likely to have difficulty becoming aroused when they are with their real partners (Prause & Pfaus, 2015).

Internet pornography can also affect an individual's romantic relationships. However, these effects are much more complex than researchers anticipated and are affected by whether an individual's significant other has a similar attitude toward pornography (Brown et al., 2017). A larger concern is the effect internet pornography could have on the attitudes and behaviours of adolescents (Koletić, 2017). Although most pornography involves fictitious situations, the ease with which simple settings turn into sexual scenarios may influence adolescents' expectations about how normal relationships work. Additional research will be necessary to determine whether adolescent pornography use has a lasting impact upon individuals' sexual behaviours as adults.



Technology has dramatically changed the accessibility of sex-related material. A growing number of researchers are

investigating the negative—and positive—effects of using cell phones and the internet for sexual activities.

Igor Stevanovic/123rf.com

The sexualization of the internet also feeds into an additional phenomenon in society: the *incel movement*. Incels are a group of males who are involuntarily celibate (i.e., they do not have a sexual partner). What sets them apart from most males is that they react to the celibacy by making hateful and derogatory statements about women, often in online forums. Incels believe that it is the duty of women to have sex with men. Incel websites frequently involve hate-filled discussions of violent fantasies. The frustration and hatred generated by the incel movement has led to several shootings and other violent acts, including the April 25, 2018, massacre by van of ten people (eight women) in Toronto.

The topics discussed in this module show us that the motivation for sex is strong. It also shows us that members of our wired world—particularly adolescents and young adults—need proper sex education so that this motivation is linked to the idea of respect.

Module 11.2 Summary

Listen to the Audio

11.2a Know . . . the key terminology associated with sexual motivation.

Review Module 11.2

Start Over Swap

0/13 REVIEWED · 0 MASTERED

sexual response cycle

Previous Next Got It!

11.2b Understand . . . similarities and differences in sexual responses in men and women.

The similarities in sexual response cycles found in men and women can be explained by a common reproductive physiology in both sexes.

However, males experience a distinct phase called the refractory period, during which erection or orgasm is not physiologically possible. Both males′ and females′ sexual behaviours are also influenced by gender scripts and sexual roles, factors that are affected by the culture in which the sexual behaviours are taking place.

11.2c Apply . . . your understanding of sex and technology to examine your attitudes toward different forms of digital and online sexual activity.

The research reviewed in the Sex and Technology section of this module suggests that cell phones and the internet are a common outlet for sexual motivations. But not everyone is comfortable discussing sexual activity online or engaging in digital sexual activities via their computer or cell phone. The questionnaire contains several items taken from a cybersex questionnaire developed by Sevcikova and Konečný (2011). The goal of including it here is to have readers examine their attitudes toward different forms of digital sexual behaviour.

Apply Activity Questionnaire

Please respond to each item on the following scale according to how often you have engaged in that behaviour online or by text:

1 = Never

2 = Only once

3 = Several times over the past year

4 = At least once a month

5 = At least once a week

Please note that there are no “right” or “wrong” answers.

1 = Never

2 = only once

3 = serveral times over the past year

4 = at least once a month

5 = at least once a week). Please note that there are no “right” or “wrong” answers.

1. Access information related to sex (e.g., guidelines, problems, etc.) NOT including erotic videos or photos.
2. Talk/Write with a known person (a friend or partner) about sex
3. Talk/Write with an unknown person about sex
4. Discuss one’s own sexual experience with a known person (e.g., a friend)
5. Discuss one’s own sexual experience with an unknown person
6. Discuss with a known person their own sexual experience
7. Discuss with an unknown person their own sexual experience
8. Send an erotic photo of yourself to someone else
9. Receive an erotic photo of someone else

The percentage of respondents having engaged in the behaviour at least once: (1) 54%, (2) 60%, (3) 23%, (4) 46%, (5) 17%, (6) 51%, (7) 20%, (8) 12%, (9) 27.5%. You may also add up the numbers to get your total score. For sexually active teens in this study, the average was 19 as compared to teens who had experience with kissing (average = 14).

Source: Sevcikova, A., & Konečný, Š. (2011). An exploration of the relationship between real-world sexual experience and online sexual activity among 17 year old adolescents. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 5*(1), article 3.

11.2d Analyze . . . different explanations for what determines sexual orientation.

Several lines of evidence point to biological factors contributing to homosexuality. For example, small differences in brain anatomy—particularly in the hypothalamus—have been observed between homosexual and heterosexual males. Also, twin studies indicate that homosexuality has a significant genetic component, particularly in males. However, biological factors cannot perfectly predict sexual orientation. There is clearly an interaction between biological and environmental factors.

Module 11.3 Social and Achievement Motivation

Listen to the Audio

Inti St Clair/DigitalVision/Getty Images

Learning Objectives

11.3a Know . . . the key terminology of social and achievement motivation.

11.3b Understand . . . how people experience a need to belong.

11.3c Understand . . . the different forms of love.

11.3d Apply . . . theories of motivation to understand different motivations for success in school or at work.

11.3e Analyze . . . claims that a sense of belonging is something people need versus something they want.

Michelle sat at the end of the gymnasium, watching the varsity girls' basketball team warming up for their game. She was younger than most of the women on the team, but still desperately wanted to be a part of it. She loved playing basketball with her friends, a couple of whom had made the team, and decided that if she was going to be a part of it next year, she would have to practise every day. She would also have to work on the skills that were currently weaknesses so that she could become a better player.

This story is very familiar—all of us know someone who vowed to work hard in order to make a team or to improve their position in an organization. The over-arching question of this module is, "Why do we try to achieve these goals?" What is motivating Michelle to work hard to be on the high-profile basketball team with her friends? And what factors will make it more or less likely for Michelle to succeed?

Everyone acknowledges that humans need to satisfy needs for food, water, clothing, and shelter in order to survive. Each of these needs is associated with a motivation, some sort of psychological process that will

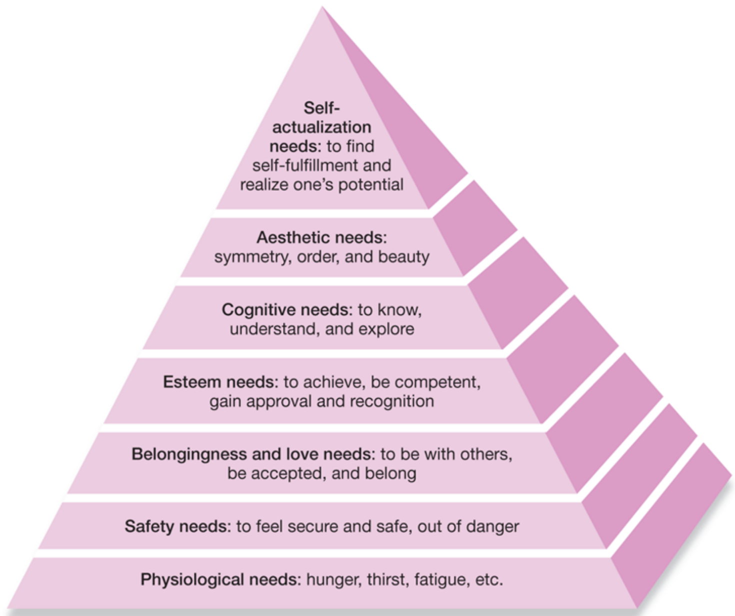
cause us to perform a particular behaviour. The need for food would lead to the behaviour of eating. The need for water would lead to the behaviour of drinking. But humans have many types of needs, some of which are less straightforward than the need to eat. These involve social processes, as well as our need for meaning and a purpose in life. In this module, we discuss some of these social and achievement needs, and try to understand the psychological processes that accompany them.

Belonging and Love Needs

Listen to the Audio

When we think about our different needs, it seems like common sense that some things are more important than others. Eating would obviously be more important than having high self-esteem, for example. In an early attempt to understand the different motivations that drive human behaviour, Abraham Maslow (1943, 1954) described a *hierarchy of needs*, with needs associated with our basic physiological survival being more important than social or achievement needs (see Figure 11.10). According to Maslow, once survival needs are met, then we can move to higher-level needs such as belonging or the need for self-esteem. At the highest point of this model lies **self-actualization**, *the point at which a person reaches his or her full potential as a creative, deep-thinking, and accepting human being*.

Figure 11.10 Maslow’s Hierarchy of Needs



According to Abraham Maslow, human needs are organized as a hierarchy with basic needs at the bottom and personal fulfillment and other uniquely human characteristics at the top.

Although Maslow's depiction of human needs and motivations seems logical, numerous researchers have criticized this model. First, the idea that we must fulfill one need before moving on to the next (in a way that is similar to levels of a video game) is simplistic (Wahba & Bridwell, 1976). You know from your own life that it is possible to have multiple motivations simultaneously—you can be striving to self-actualize while also experiencing the need to achieve at school. A second criticism was that the hierarchy appeared to be biased toward an individualistic (Western) culture (Hofstede, 1984). Self-actualization, the peak state of Maslow's model, consists of a number of characteristics that put the individual's needs or goals first, sometimes at the expense of humanity as a whole. In collectivistic (primarily Eastern) cultures, such needs would be much less important than acting to ensure that everyone was getting along and that the community, not just the individual, was successful.

However, although the *hierarchy* element of Maslow's model may be inaccurate, his work has highlighted the fact that human motivation extends to a number of different areas rather than being simply a matter of eating, sleeping, and reproducing. Later researchers have noted that we have a number of needs that can, at times, feel as pressing as a grumbling stomach. For example, research suggests that humans have a fundamental need to belong (Baumeister & Leary, 1995), which motivates us to affiliate with other people and to seek meaningful, long-term bonds.

Belonging Is a Need, Not a Want

Listen to the Audio

The **need to belong** (sometimes known as affiliation motivation) *is the motivation to maintain relationships that involve pleasant feelings such as warmth, affection, appreciation, and mutual concern for each person's well-being*. In addition, an individual must have the sense that these feelings are part of a permanent relationship, such as a friendship, kinship, or shared group membership (Baumeister & Leary, 1995). A strong sense of belonging brings more than warmth and happiness; it appears to be fundamental in the same way that food and shelter are needs—these are all things that humans cannot survive without.

Although we all probably want to have pleasant interactions, it is the second part of the definition—a sense of permanence—that is most important for our well-being. Specifically, an individual who has many positive social interactions with a series of different individuals does not enjoy the same satisfaction and other benefits as an individual who interacts with only a few people, but regularly and for a long period of time. For example, an executive who flies all over the continent may have fascinating conversations with fellow passengers every week, yet feel extremely lonely. Meanwhile, imagine a couple living on a rural farm who see only a few neighbours during the week, but see the same people frequently and know them very well. The permanence of their family and community is significant, and they will probably be much more satisfied with their sense of belonging over the long run than will the high-flying executive. Indeed, a substantial number of studies have shown that lonely

people like the executive are more likely to feel depressed—and have lower life satisfaction in general—than are socially connected individuals like the rural farmers (Cacioppo et al., 2006, 2011).

In addition to its effects on mental health, psychologists have found that social connectedness has a dramatic effect on physical health. Research has demonstrated that loneliness is a risk factor for illnesses such as heart disease and cancer (Cacioppo et al., 2003). It also elevates a person's risk for having hypertension, a weaker immune system, and high levels of stress hormones. This relationship holds true even when lonely and non-lonely individuals have the same amount of social interaction—it is the *sense of belonging* that counts (Hawkley et al., 2003). Even very simple indicators such as living alone or an individual's rating of the statement "I feel lonely" predict chances of survival after heart attacks and bypass surgeries (Herlitz et al., 1998; Rozanski et al., 1999). Given that belonging is important for health and happiness, it makes sense that so much of a person's life is focused on friends, family, and romantic partners.

Love

Listen to the Audio

In some cases, the feeling of belonging that accompanies your friendship and family bonds becomes a form of love. You'd be willing to make great sacrifices for these lucky people and you know they would do the same for you. You trust them, look forward to spending time with them, and genuinely cheer for them as they go through life. Of course, this isn't the only type of love that we experience. As you stumble through your teenage years and enter early adulthood, many of you will desire and experience romantic relationships. Some of these will produce an intense feeling that we think of as romantic love.

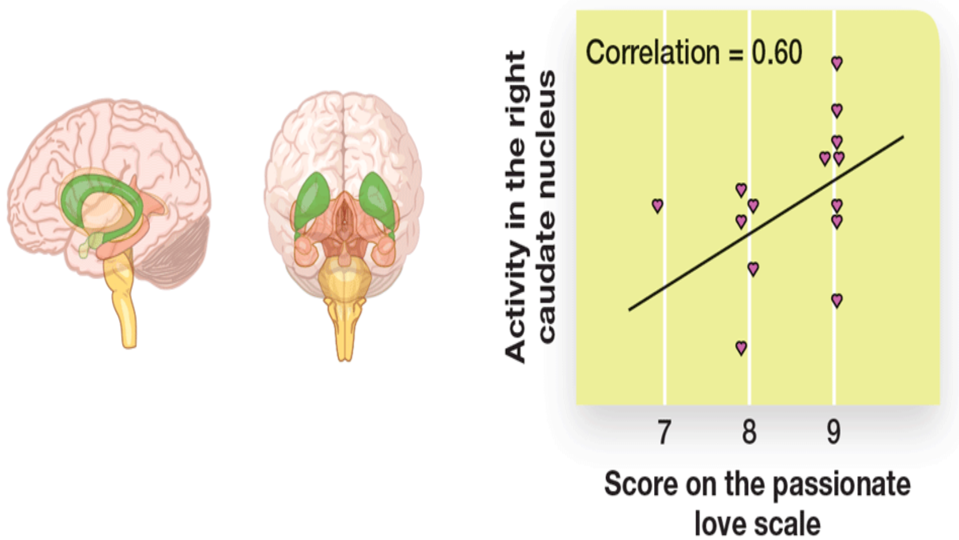
What *is* romantic love? This is a question that has permeated our culture for thousands of years. Armies of anemic English poets have worked furiously, desperately trying to find the perfect words to describe this wonderful feeling. For most of our history, love has not been seriously discussed in scientific circles. However, this has changed in the past 45 years. In 1974, Berscheid and Walter proposed the first scientific model of love, one that is still widely accepted today (Fehr, 2003). These psychologists suggested that love is composed of two main components: passionate love and companionate love. **Passionate love** *is associated with a physical and emotional longing for the other person*. We feel passionate love at the beginning of a relationship, when we are just getting to know the other person and everything is new. Brain imaging research has shown that feelings of passionate love are associated with activity in areas of the brain related to physical rewards as well as the insula, a region that

is sensitive to internal bodily feelings such as having “butterflies in the stomach” (Bartels & Zeki, 2004; Beauregard et al., 2009).

Companionate love, on the other hand, *is related to tenderness, and to the affection we feel when our lives are intertwined with another person* (Hatfield & Rapson, 1993). Although passionate love is certainly more exciting, companionate love appears to have a greater influence on the long-term stability of a relationship. Undergraduate research participants viewed increases in companionate features of love to be more indicative of a loving relationship than passionate features of love. Decreases in companionate love suggested that the relationship was in trouble (Fehr, 1988), and may suggest that the people do not feel as committed to each other as they once did.

Love, therefore, seems to be a very pleasant state. But what *motivates* people to seek it out? Arthur Aron and his colleagues (2005) have suggested that “love is a mammalian drive to pursue preferred mates” (p. 327). In other words, love may be a goal-oriented state in a way that is similar (but obviously not identical) to hunger and sex drives. To test this hypothesis, these researchers performed fMRI scans on 17 people who were in love. While in the scanner, these participants viewed images of their special someone, as well as photographs of a familiar person. The brain responses to images of the loved one were stronger in dopamine-rich areas that are part of the reward system. Even better, activity in some parts of this system correlated with the participants’ responses on a passionate love questionnaire (see Figure 11.11). Activity in other parts of the reward system correlated with the intensity of their reported love and with ratings of facial attractiveness. Importantly, many of these brain areas contain receptors for oxytocin, the hormone related to feelings of trust and the desire to be close to someone.

Figure 11.11 Love as a Motivational System



(*Left*) Neuroimaging data show that viewing images of your beloved (as opposed to another familiar person) activates the caudate nucleus (the green structures in the brain images), an area in the brain related to experiencing rewards. (*Right*) People who felt greater levels of passionate love showed larger reward responses.

Source: Adapted from Aron, A., Fisher, H., Mashek, D. J., Strong, G., Li, H., & Brown, L. L. (2005). Reward, motivation, and emotion systems associated with early–stage intense romantic love. *Journal of Neurophysiology*, *94*, 327–337 (Fig. 3).

It is important to note that this motivational view of love is still consistent with the passionate–companionate theory of love. In fact, it adds a mechanism that can explain why we seek out passionate love in the first place: a reward state similar to many other types of motivations.

Belonging, Self-Esteem, and Our Worldview

Listen to the Audio

Belonging to a group provides us with a number of benefits, ranging from physical security (the safety of a group) to the possibility of love (and, in some cases, mating). Belonging also provides individuals with a culture, a group of people who share their view of the world. Feeling as though you are part of a larger, connected group has a number of benefits, ranging from improved health (see Module 14.1) to a greater ability to cope with stress (see Module 14.3). It also helps us deal with more philosophical fears, such as our fear of dying.

Working the Scientific Literacy Model

Terror Management Theory and the Need to Belong

Listen to the Audio

As far as scientists can tell, humankind is the only species on earth that is aware of its own mortality. This realization creates some uniquely human problems. How do we cope with the knowledge that we will one day die? Many of us find support through some combination of our personal identities, family and friends, religious beliefs, and connection with our community. So in some ways, our need to belong may be linked with our fear of dying. Observations such as this led to the development of **terror management theory (TMT)**, *a psychological perspective asserting that the human fear of mortality motivates behaviour, particularly behaviours that preserve self-esteem and our sense of belonging*.

What do we know about terror management theory?

The knowledge of death has the potential to be terrifying; however, very few of us experience this anxiety on a daily basis. Instead, we tend to use *anxiety buffers*—concepts and beliefs that prevent death-related anxiety from entering our conscious mind (Becker, 1971, 1973; Solomon et al., 1991). One anxiety buffer is known as the *cultural worldview*, a belief system about how our world should work. This system provides us with a sense of order and stability in life, feelings that makes it seem as though death

were not an immediate possibility. Cultural worldviews can also consist of religious beliefs that influence how we think about the world around us and that provide us with a belief in an afterlife. For people who are not religious, the worldview still provides comfort—the culture that we are a part of will continue even after we are gone (Hayes et al., 2010). An added benefit of a cultural worldview is that it gives people a set of standards that they can live up to. Doing so helps us feel significant and valued, feelings that make up the anxiety buffer that is *self-esteem*. According to TMT, our cultural worldview and self-esteem protect us from the fear of our own mortality. Not surprisingly, most of us are quite protective of them.

How can scientists study terror management theory and the need to belong?

Psychologists typically study TMT by manipulating how aware participants are of death, something they refer to as *mortality salience*. For example, participants might be asked to write a paragraph or two about what happens to our bodies when we die. A control group would write about something that is unpleasant but that does not make mortality more salient (e.g., the discomfort of a root canal). After a brief delay, participants are then presented with stimuli such as a short essay that either criticizes (experimental group) or does not criticize (control group) the participant's cultural worldview; examples might include written passages that were critical of the person's country or university. Participants are then asked to indicate how strongly they agree or disagree with the essay. In most studies, simply writing about death is enough to motivate people to defend their worldview more strongly than participants in the control group, even though individuals were randomly assigned to different conditions.

Importantly, psychologists have also identified ways to reduce the impact of mortality salience. For example, when psychologists followed the mortality-salient stimuli with an exercise in which participants generated positive thoughts about their parents, the effects of mortality salience disappeared (Cox et al., 2008). This and similar experimental procedures suggest that belonging to something more permanent—a family or a community—really does help manage death- related anxiety.

Can we critically evaluate this evidence?

When TMT research began three decades ago, many critics questioned whether it was really thoughts of death that created these experimental effects, or whether the effects simply represented a reaction to the unpleasantness of the study materials. Terror management theorists quickly pointed out that the same effects did not arise among members of control groups who were exposed to unpleasant stimuli ranging from dental pain to the anxiety of public speaking (Greenberg et al., 2008). Indeed, a review of 277 experiments confirmed that responses to mortality salience can be reliably produced in the laboratory (Burke et al., 2010).

Additional support for TMT was provided by Jeff Schimel and his colleagues at the University of Alberta. Rather than showing that our worldview protects us from thoughts of mortality, these researchers examined whether death-related thoughts would *increase* if our worldview was somehow compromised (Schimel et al., 2007). In their study, participants read a brief essay criticizing either the Canadian healthcare system or the government of another country. Participants who read the essay that played down the benefits of Canada’s health care (i.e., an attack on our worldview) were more likely than the control group to complete word fragments with death-related words (e.g., completing

COFF- - to make COFFIN rather than COFFEE). These results provide additional evidence that our worldview and our awareness of death and mortality are linked.

Why is this relevant?

TMT has a strong link to politics. Numerous researchers have noted that mortality salience makes people more extreme in their beliefs (Burke et al., 2013), often leading them to become more politically conservative in their statements and attitudes (Jost et al., 2003). This is likely because conservative ideologies and political parties provide unambiguous solutions for death-related problems (e.g., a War on Terror), whereas liberal ideologies and political parties are more likely to promote change, which is by its very definition uncertain. An example of this *conservative shift* came in the 2004 American election. TMT researchers found that when potential voters were exposed to mortality salient information, they became more likely to support Republican (conservative) President George "Dubya" Bush rather than Democratic (somewhat liberal) candidate John Kerry (Cohen et al., 2005; Landau et al., 2004). The fact that Donald Trump's 2016 election platform was based primarily on the fear of immigrants and Muslims suggests that this effect did not go unnoticed by Republican strategists. Indeed, as president, Mr. Trump has repeatedly used mortality salience in his speeches, often referring to illegal immigrants as murderers and rapists.

Mortality salience is also used in Canadian elections. Conservative politicians tend to discuss the need for tougher sentences for criminals (mortality salience) more than other parties. And, quite recently, then–Prime Minister Stephen Harper suggested during the 2015 election campaign that Muslims taking the Canadian citizenship oath shouldn't be allowed to wear head coverings. His government was also providing frequent

reminders that Canada could suffer a terrorist attack (mortality salience). It is important to note that we are not telling you who to vote for! But it is also important that you vote for a party based on its ideas, not because of your fear of death and your need to belong.

Psychologists have found that people respond to mortality salience by becoming more protective of their cultural worldview. Politicians sometimes use this tendency to try to influence voting behaviour.

Seyit Aydogan/Anadolu Agency/Getty Images

Achievement Motivation

Listen to the Audio

At the beginning of this module, you read about Michelle, a student who desperately wanted to be on the varsity basketball team. Part of that desire was likely related to the need to belong, to be part of a team with her friends. But that can't explain why she vowed to practise every day so that she would make the team next year. It would be much easier to join a team in a lower-level basketball league, or to have her friends put together a team in a different sport. But, these solutions weren't part of Michelle's story. Instead, she wanted to improve her basketball skills so that she could be part of the competitive and prestigious league. In other words, she wanted to achieve a specific goal.

Achievement motivation is a very strong force in human behaviour, and refers to *the drive to perform at high levels and to accomplish significant goals*. But this motivation isn't as simple as it sounds. There are a number of reasons *why* Michelle could be motivated to achieve. For example, Michelle might want to make the team in order to receive more respect and attention from her fellow students. She might also really enjoy the game and could have a desire to play it as much as possible. In both cases, Michelle would be attempting to achieve an **approach goal**, *an enjoyable and pleasant incentive that a person is drawn toward, such as praise, financial reward, or a feeling of satisfaction*. But what if Michelle were motivated to make the team in order to avoid the embarrassment of being "cut" from the team this year? That's a very different mindset than an approach goal. Instead, her behaviour would be motivated by an

avoidance goal, *an attempt to avoid an unpleasant outcome such as shame, embarrassment, losing money, or feeling emotional pain*.

Review Applying Concepts of Achievement Motivation, Part A: Approach-Mastery

Thinking about your psychology course, respond to each statement by assigning a score on a scale of 7 (“Strongly Agree”) to 1 (“Strongly Disagree”). Once you answer the three items you can see how you compare with an average based on a research sample. Click Next to begin.

Previous Next

Review Applying Concepts of Achievement Motivation, Part B: Avoidance-Mastery

Thinking about your psychology course, respond to each statement by assigning a score on a scale of 7 (“Strongly Agree”) to 1 (“Strongly Disagree”). Compare your scores to the averages for each score. Click Next to begin.

Previous Next

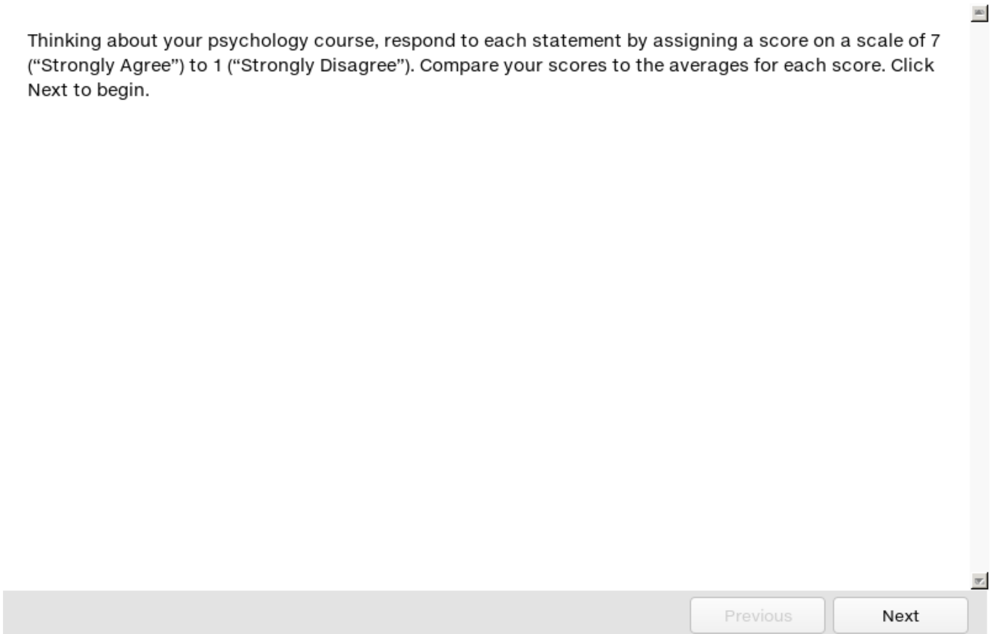
Review Applying Concepts of Achievement Motivation, Part C: Approach-Performance

Thinking about your psychology course, respond to each statement by assigning a score on a scale of 7 (“Strongly Agree”) to 1 (“Strongly Disagree”). Compare your scores to the averages for each score. Click Next to begin.

Previous Next

Source: Applying Concepts of Achievement Motivation, Parts A to D, pg. 842: Add credit: Source: Based on Elliot, AJ & McGregor, HA (2001). A 2 × 2 achievement goal framework. Journal of Personality and Social Psychology, 80, 501-519.

Review Applying Concepts of Achievement Motivation, Part D: Avoidance-Performance



If achievement motivation were this simple, we could explain most of our behaviour in terms of seeking a reward and/or avoiding suffering. Although both are elements of our behaviour, our motivation to achieve is also influenced by numerous other factors. In the rest of this module, we will discuss how these different factors can influence our motivation to achieve our goals.

Self-Determination Theory

Listen to the Audio

When we think about achieving our goals, we can't help but think about making up to-do lists or pro-and-con lists that will help us organize our lives. But, while these techniques provide us with a practical way of examining the choices we face, they don't really tap into the deeper motivation for why we are, or are not, performing a behaviour. Psychological research has attempted to fill this void by examining what researchers refer to as universal needs—needs that (almost) all humans experience. Researchers have identified three universal needs (Deci & Vansteenkiste, 2004):

- *Relatedness:* Feeling connected with others, a need satisfied by forming meaningful bonds with other people such as family members, teammates, or colleagues at school and work
- *Autonomy:* The need to feel in control of your own life
- *Competence:* The ability to perform a task at a skill level that is satisfying to the individual

But our motivation isn't necessarily influenced by how competent we *are*. Instead, it is influenced by how competent we *think* we are. If a very skilled basketball player didn't think she was good enough, she wouldn't practise as hard as she would if she believed in her abilities. (In contrast, watch some of the awful singers making the judges' ears bleed on *American Idol*-type shows; they believe they are good, so they continue to sing . . . sometimes even while security drags them away.) The effect that

your perception of your own ability has on motivation is known as **self-efficacy**, *an individual's confidence that he or she can plan and execute a course of action in order to solve a problem* (Bandura, 1997). When people experience high levels of self-efficacy, their performance improves and they are motivated to choose more challenging tasks to perform (Eccles & Wigfield, 2002). So, if you believe that you can competently do something, you will be more motivated to attempt to do so.

During the mountain stages of competitive cycling races such as the Tour de France, many riders will suddenly lose speed and fall behind the other riders trying to climb the steep mountain roads. This occurs even when the rider is in amazing physical condition. Television commentators say that the cyclist has "popped." Psychologists would say that the rider lost his feeling of self-efficacy.

Rupert Rivett/Alamy Stock Photo

A theme running through all three of our universal human needs—relatedness, autonomy, and competence—is the need to feel in control of our life and our decisions. We want to be able to choose who we associate with and the form those relationships are going to take

(relatedness), control the decisions that affect our lives (autonomy), and be in control of the actions necessary to carry out those decisions (competence). These themes are part of **self-determination theory**, *a theory that states that an individual's ability to achieve their goals and attain psychological well-being is influenced by the degree to which he or she is in control of the behaviours necessary to achieve those goals* (Ryan & Deci, 2000). So, if we are able to achieve this control, or at least feel like we have control, then we will be more motivated to perform the actions necessary to achieve that goal. We will also be happier. Self-determination theory has been used to explain a number of behaviours, ranging from the likelihood of successfully learning a second language (Noels et al., 2000), to the motivation to exercise (Wilson et al., 2008), to the establishment of healthy identities (La Guardia, 2009), and to the ability to adapt to life as an international student studying in Canada (Chirkov et al., 2007, 2008). In each case, increasing feelings of competence, autonomy, and relatedness increased motivation.

But, at this point in our discussion, our explanation for why we are motivated to achieve goals only explains very general, deep-seated needs. To more thoroughly explain our behaviours, we need to look more closely at specific factors that could influence motivation.

Extrinsic and Intrinsic Motivation

Listen to the Audio

One way to examine the question of "Why do we try to achieve a goal?" is to determine whether our motivation is externally or internally generated. If you wanted to be on a basketball team in order to be popular, you would be experiencing **extrinsic motivation** (or a **performance motive**), *motivation geared toward gaining rewards or public recognition, or avoiding embarrassment* (Deci, 1971; Vansteenkiste et al., 2006). This form of motivation is not always the most effective, as it requires a person to give up some autonomy. If you play basketball to seem cool, then you must rely on other people's reactions to determine if you succeeded in your goal (i.e., other people control whether you are viewed as "cool"). Taken to its most extreme, people can become **amotivational**, *a feeling of having little or no motivation to perform a behaviour*. If your parents forced you to play basketball against your will, you might stop putting forth any effort. In this case, neither the feelings of autonomy nor competence would be met.

Luckily, not all of our motivation is controlled by outside forces. Sometimes we do things simply because we enjoy doing them. For example, what if you wanted to become a better basketball player simply for the joy of playing and improving yourself? In this case, the motivation to improve came from within yourself rather than from some external source. This would be an example of **intrinsic motivation** (or **mastery motive**), *the process of being internally motivated to perform behaviours and*

overcome challenges (e.g., a genuine desire to master a task rather than being motivated by a reward).

A study of grade 5 students showed the profound effect that intrinsic and extrinsic motivation can have on how we respond to challenges and to failures (Mueller & Dweck, 1998). Children were given sets of puzzle problems and were asked to complete them independently. After successfully solving the first set of puzzles, some of the students were praised for their intelligence (e.g., "You must be smart to do these problems") while others were praised for their work ethic (e.g., "You must have worked hard at these problems"). The psychologists then gave the children another, more difficult, set of problems to complete. This time, the researchers told the children that they had scored lower on these questions. Finally, the children were asked to select the goals that they tended to work toward. This list included performance/extrinsic goals such as choosing easy questions to avoid getting many wrong, as well as mastery/intrinsic goals such as selecting problems that one could learn from.

The results of the experiment were remarkable. The children praised for being smart tended to feel less pleasure during learning and instead tended to worry about how well they were doing. They gave up more easily and performed more poorly. Just under 70% of these students selected performance/extrinsic goals when given a list of options. In contrast, only 10% of the students who were praised for their effort chose performance/extrinsic goals when asked what motivated them. Instead, they focused on working hard, overcoming challenges, and learning from their mistakes. Even more stunning was the fact that the students praised for being smart were three times more likely to lie about their results to other people. Almost 40% of the "smart" students lied about their results, compared with only 13% of the "effort" students (Mueller & Dweck, 1998). In summary, the students praised for intelligence felt incredible

pressure to live up to that label and went to great extents to preserve that image, including selecting easier questions and lying about their results. Based on this study, what parenting techniques do you think would help kids become well-adjusted?

Stephen Smith

Intrinsic motivation occurs when someone is internally motivated to perform a behaviour. These behaviours can range from school or work performance to playing sports to learning a new skill. In the case of children, the parents, coaches, and educators must balance their goal of helping the children improve their performance with the need to allow the children to maintain feelings of autonomy and competence.

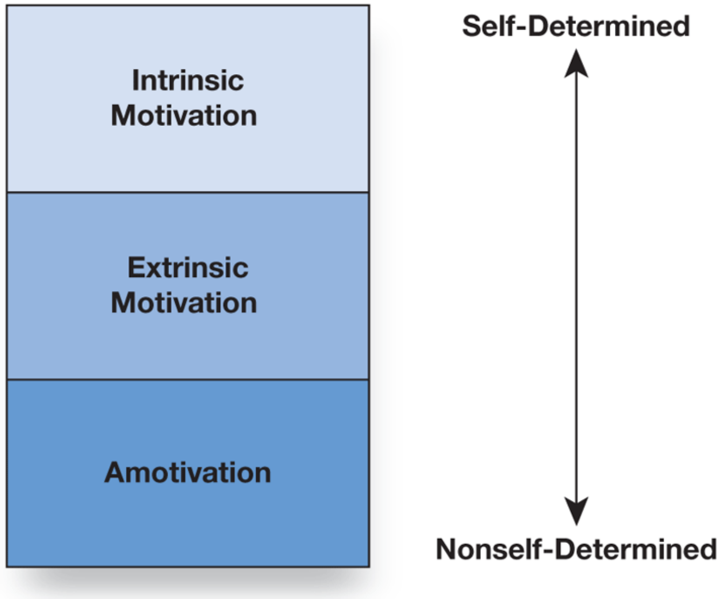
Hoxton/Alamy Stock Photo

A Continuum of Motivation

Listen to the Audio

It is important to note that intrinsic and extrinsic motivation are not completely separate. Rather, intrinsic motivation, extrinsic motivation, and amotivation can be placed on a continuum that depicts how much self-determination an individual might feel for those behaviours (see Figure 11.12). Critically, where a given behaviour lies on this continuum can change over time or across situations. Take, for example, behaviours that were initially extrinsically (externally) motivated. Generally, these behaviours are not associated with much passion, as some outside motivation (e.g., money or another person) is stimulating this behaviour. But, over time, it is possible that some of these behaviours will become *internalized* so that they are part of a person's identity. A basketball player might begin working out because it will increase the odds that they will be recruited to play for a team and will become popular. Over time, however, they might become enthusiastic about exercising for its own sake and could make that part of their identity long after their basketball career ended. By making exercising part of their identity, the basketball player gains autonomy over this behaviour because *they* are the one motivating it, not some external source like a coach. Internalized behaviours are more likely to be performed—and performed well—than extrinsically motivated behaviours that are not internalized.

Figure 11.12 The Continuum of Self-Determination Theory



On this continuum, amotivation would reflect very low levels of self-determination. Intrinsic motivation, on the other hand, would reflect a high degree of self-determination.

Myths in Mind

Rewards Improve Motivation

People generally like being rewarded for their behaviour. Receiving an unexpected gift from an employer along with a "Well Done!" note can increase a person's desire to work just as hard in the future. However, the relationships between motivation and rewards are not as simple as you might expect. For instance, if you give someone a reward (other than verbal praise) for an intrinsically motivated behaviour, the intrinsic motivation decreases, as does the frequency of the behaviour. This change in motivation is known as *the over-justification effect* (Lepper et al., 1973). This decrease in motivation is likely due to the change from being internally motivated (high

> autonomy) to being dependent upon a reward (low autonomy). So, if you loved basketball, but then started receiving money from your parents for each basket, you would actually feel less motivated to play than you did before! This effect has profound implications for parenting, education, and the business world. For example, if good students were given rewards for getting good grades, it might reduce how much they identified themselves with learning. Businesspeople who work in the hopes of getting a bonus monetary reward will be less likely to identify with the projects or products they are working on. In both cases, the rewards have moved their motivation along the continuum from intrinsic toward extrinsic. This isn't to say that rewards should never be given; sometimes this is the only option to motivate someone. However, as we learn more about the over-justification effect, it is becoming increasingly clear that we need to more carefully consider the effects of rewards on behaviours that were already intrinsically motivated.

Of course, there is one important limitation to our discussion of intrinsic and extrinsic motivation: most of the studies used data from university students in Western countries. Recently, psychologists have begun to examine whether motivational processes differ across cultures.

Cultural Differences in Motivation

Listen to the Audio

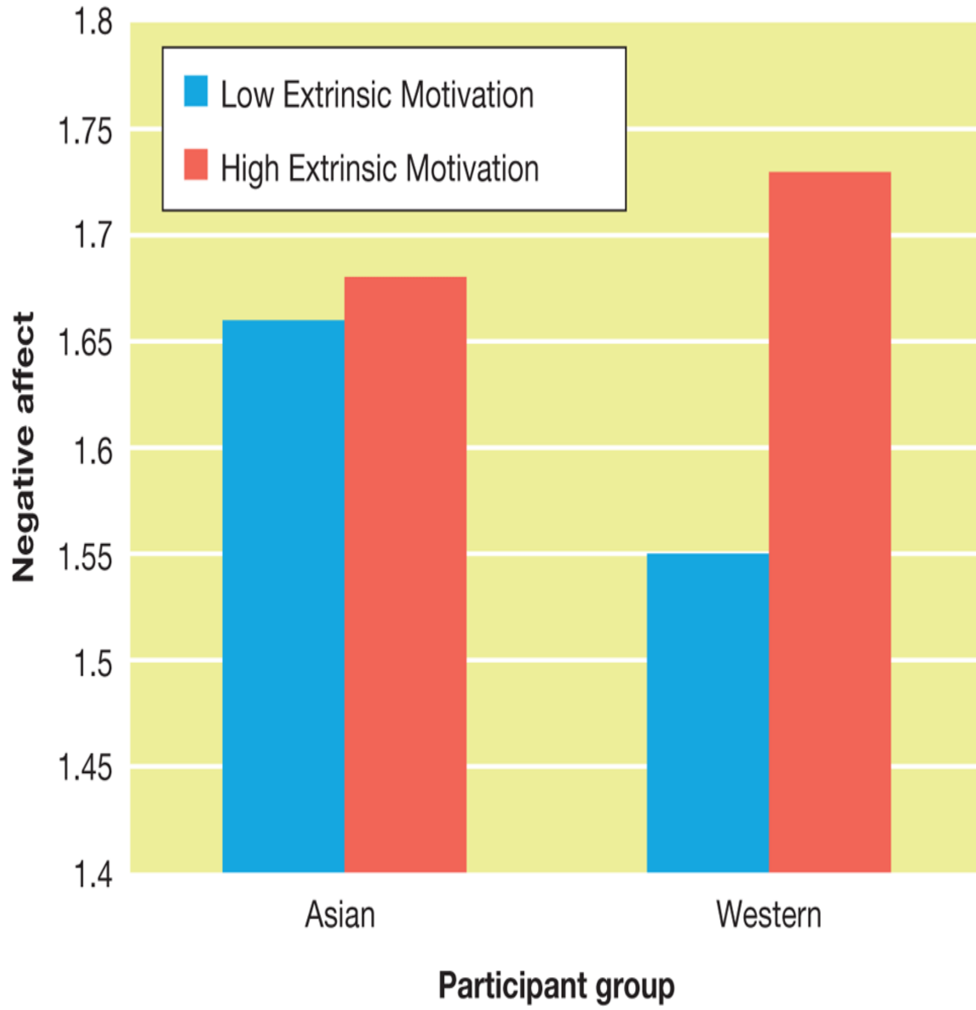
The fact that there are cultural differences in motivation should surprise no one. Western culture tends to promote autonomy and the individual, whereas Eastern cultures put more emphasis on meeting the needs of the community. In other words, the actions of North Americans are often controlled by the individual, whereas the actions of people in Eastern cultures (e.g., East Asians) are often jointly controlled by the individual and their family and community (Markus & Kitayama, 2003). As a result, while intrinsically motivated behaviours should lead to positive performance and emotions across cultures, the responses to extrinsically motivated behaviours might differ. Specifically, people in individualistic cultures like Canada and the United States will be less motivated to perform these behaviours than people from "collectivistic" Eastern culture. This latter group will view extrinsically motivated actions as being performed to help their family or community. In fact, if these individuals feel like they are making the decision to act collectively, they will experience an improvement in subjective well-being similar to that found when they engage in intrinsically motivated behaviour (Chirkov et al., 2003).

Cultural differences have also been observed in the motivation to improve one's self. Researchers at the University of British Columbia, in collaboration with colleagues in Kyoto, Japan, examined how Canadian (of European ancestry) and Japanese students responded to failure (Heine et al., 2001). Participants were asked to complete a Remote Associates

Task in which they were asked to identify a word that linked together three other words (e.g., *dust, struck*, and *ship* could be linked by the word *star*). The participants were told that this test measured emotional intelligence and creativity. The researchers found that Japanese participants were more motivated to work on the task after failing than after performing well; European-Canadian participants showed the opposite pattern. Follow-up studies found that these differences were likely due (in part) to cultural differences in the importance of effort in success. Failure decreased motivation to work in Canadian students but increased motivation in Japanese students (Heine et al., 2001).

Culture may play a slightly more complicated role for some Canadians, however. Many people in our country are first- or second-generation immigrants from another culture. They can therefore identify with their family's ancestral culture (e.g., China) or with their current culture (Canada, a "Western" society). How are these *bicultural* individuals influenced by intrinsic and extrinsic motivation? It turns out that the answer depends upon which culture the individual identifies with at any given moment. Using a diary study in which participants were prompted to submit electronic entries at different points in the day for 10 days, Elaine Perunovic and her colleagues found that when bicultural Asian Canadians identified with Western culture, extrinsic motivation was linked with negative emotions, likely due to a loss of a feeling of autonomy (see Figure 11.13). In contrast, when these participants identified with their Asian culture, their levels of negative emotions were unaffected by extrinsic motivation. There were no cultural differences in intrinsic motivation (Perunovic et al., 2011).

Figure 11.13 Cultural Differences in Extrinsic Motivation



Extrinsic motivation was linked with negative emotions when Asian Canadians identified with their Western culture. It did not affect negative emotions when participants identified with their Asian heritage. Intrinsic motivation showed no cultural differences.

Source: Perunovic, W.Q.E, Heller, D., Ross, M., & Komar, S. (2010). The within-person dynamics of intrinsic and extrinsic motivation, affective states, and cultural identification: A diary study of bicultural individuals. *Social Psychological and Personality Science*, *2*(6), 635–641. Fig. 1, p. 639.

Taken together, these results show that motivation can be influenced by culture. It also shows the power of the need to belong—the Eastern focus on the community rather than the individual made extrinsically motivated behaviour seem less like a burden and more like a group decision.

Module 11.3 Summary

Listen to the Audio

11.3a Know . . . the key terminology of social and achievement motivation.

Review Module 11.3

Start Over Swap

0/15 REVIEWED · 0 MASTERED

intrinsic motivation

Previous Next Got It!

11.3b Understand . . . how people experience a need to belong.

Psychologists have discovered a number of ways in which people are motivated to enter into personal relationships. People seek out

friendships, romantic relationships, and group membership to satisfy this need.

11.3c Understand . . . the different forms of love.

Passionate love involves a physical and emotional longing for the other person. It typically occurs at the beginning of a relationship. Companionate love involves the tenderness and affection felt when a person's life is intertwined with another person's. Companionate love has a greater influence on the long-term stability of relationships.

11.3d Apply . . . theories of motivation to understand different motivations for success in school or at work.

In this module, you learned about the difference between approach and avoidance motivation. You also learned to distinguish between mastery (implicit) and performance (explicit) motivation.

Table 11.3 Types of Motivation

For the next six examples, please indicate whether the motivation being described is an example of Approach-Mastery, Approach-Performance, Avoidance-Mastery, or Avoidance-Performance motivation.

Ruth was concerned that the B+ grade she had earned in her biology class was not high enough for her graduate school applications.	Avoidance-Performance
Rachel contacted her professor because she was afraid that she had misunderstood some of the information from her history course.	Avoidance-Mastery
Sydney enjoyed taking electronics repair courses and wanted to learn more about how to fix different electronic devices.	Approach-Mastery
Joe wanted to get the highest performance evaluation in his department at work.	Approach-Performance
Gurpreet did poorly on his French test. However, he wasn't upset because his grade was still in the top 10% of the class.	Approach-Performance
Frances attended classes even though she was sick because she was concerned about not learning all of the material in her chemical engineering course.	Avoidance-Mastery

Check Your Understanding

11.3e Analyze . . . claims that a sense of belonging is something people need versus something they want.

Although belonging may not be the most basic type of need on the hierarchy of needs—those positions are usually assigned to food, water, and shelter—it is a significant need nonetheless. Research has shown that living without a feeling of belonging has some drastic consequences. Not only is loneliness related to depression, but it is also associated with a reduced lifespan. The fact that belonging is essential to good health and longevity provides strong support for classifying it as a need, not just something people want.

Module 11.4 Emotion

Listen to the Audio

Matteo photos/Shutterstock

Learning Objectives

11.4a Know . . . the key terminology associated with emotion.

11.4b Understand . . . how the nervous system responds to emotions.

11.4c Understand . . . cultural similarities and differences in emotional expressions.

11.4d Apply . . . your knowledge of theories of emotion to new examples.

11.4e Analyze . . . what purpose(s) facial expressions serve?

Imagine the following scenario: You are sitting in your bedroom watching television. Suddenly, you notice something moving beside one of your textbooks. Your heart rate increases slightly and your palms begin to sweat as you move closer to the moving object.

At this point—before we know how this story resolves itself—it is important to examine some details about your emotional response. First, the "you" in this story was very quick to locate and pay attention to a potentially threatening stimulus; nothing else in your environment seemed to matter for that instant. The moving object could have been a leaf or clump of dust that was being moved by the air conditioning in your house. Or it could have been a spider or, worse yet, a spider with a knife. What is important to note is that before you were even able to consciously identify what the object was, your body was preparing itself to act. You were afraid, and your body responded with an increase in heart rate, sweating, and muscle tension. Once you determine whether the moving object is dangerous or not, you can either increase or decrease your emotional reaction. If it is just a dust bunny, you don't need to feel fear. However, if it is a well-armed spider, then your initial emotional response may be appropriate.

This example illustrates the key parts of an emotional experience: We detect an emotional item, we have an initial emotional reaction preparing us to respond, and then, after we analyze the situation, we increase or decrease that response. In this module, we will take a closer

look at these different parts of our emotional responses in an effort to better understand the emotions that we experience every day.

Like most concepts in psychology, the term *emotion* can mean a number of different things. Common convention in psychology is to define an **emotion** as being *a behaviour with the following three components: (a) a subjective thought and/or experience with (b) accompanying patterns of neural activity and physical arousal and (c) an observable behavioural expression (e.g., an emotional facial expression or changes in muscle tension)*. Although this definition still includes thoughts and *feelings*, it also shows that our current understanding of emotion encompasses other elements as well. In particular, it shows us that the emotions we experience include a biological response.

Children who are born both deaf and blind show the same facial expressions and emotions as people who see and hear. This is one of many pieces of evidence that our emotions have a strong biological basis.

Darren Greenwood/Design Pics Inc/Alamy Stock Photo

Physiology of Emotion

Listen to the Audio

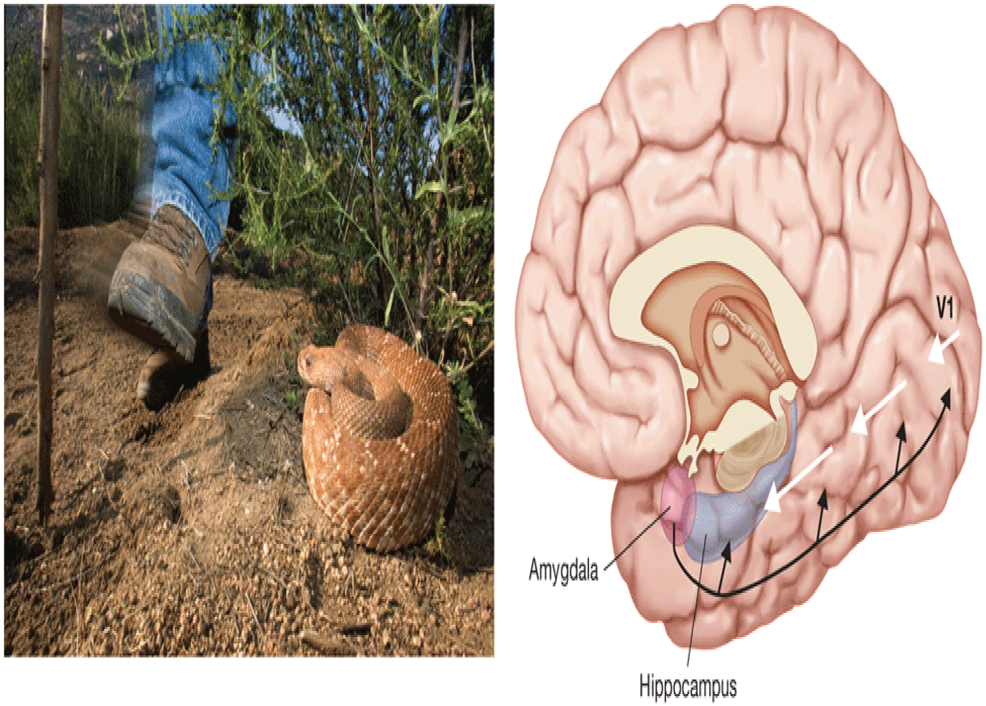
In the example at the beginning of this module, we noted that emotional behaviours are actually quite complex and involve a number of different components. Although we often think of emotional responses occurring in a number of separate stages, research suggests that this view might be a bit too simple (Pessoa & Adolphs, 2010). Instead, our neural responses to emotions are best thought of as a series of networks or loops. Each network involves a group of neural structures that work together to produce different parts of your emotional response (e.g., increased heart rate); however, these networks can also provide feedback to each other. These interactions allow you to modify your emotional responses as you learn more about your situation. In this section, we will discuss the different areas of the nervous system that are involved in emotions and will show how different areas work together to produce the emotional behaviours that have allowed our species to survive in a dangerous world.

The Initial Response

Listen to the Audio

The human brain shows emotion-dependent responses within approximately 150 ms of seeing or hearing a potential threat (Pizzagalli et al., 2002). The goal of this early activity isn't to consciously identify an emotional stimulus. Instead, the purpose of this initial brain activity is to tag or highlight that stimulus so that it receives extra processing by brain structures at later stages of perception. For an example of this phenomenon, look at Figure 11.14. There are many different objects in this scene, yet you likely paid more attention to the snake than to anything else. Why does this happen? How does your brain make some stimuli more important than others, and what consequences follow from that?

Figure 11.14 How Emotional Elements of a Scene Attract Our Attention



Most of us are very quick to notice threatening stimuli such as snakes and spiders (left panel). This ability is due, in part, to interactions between the amygdala and our sensory cortices. Sensory cortices (e.g., the visual cortex) send signals *to* the amygdala that influence its activity. Feedback *from* the amygdala causes an increase in activity in sensory regions such as the visual cortex (right panel), leading to more attention being paid to the parts of our visual world that contain the threatening stimulus. These areas continue to influence each other through these pathways.

Roy Toft/National Geographic/Getty Images
Source: Republished with permission of Elsevier Science, Inc., from Vuilleumier, P. (2005). How brains beware: neural mechanisms of emotional attention. *TRENDS in Cognitive Sciences 9*(12), 585–594. Figure 1a, p. 588. Permission conveyed through Copyright Clearance Center, Inc.

A critical brain area involved in this process is the **amygdala**, *a group of nuclei in the medial portion (near the middle) of the temporal lobes in each hemisphere of the brain*. The amygdala receives sensory input from the cortex, the outer part of your brain, approximately 200 ms after an emotional stimulus appears (Krolak-Salmon et al., 2004). The amygdala fires when we perceive stimuli that are emotionally arousing, and is especially sensitive to fear-relevant images and sounds. However, the firing of the amygdala on its own does very little—it is the amygdala’s

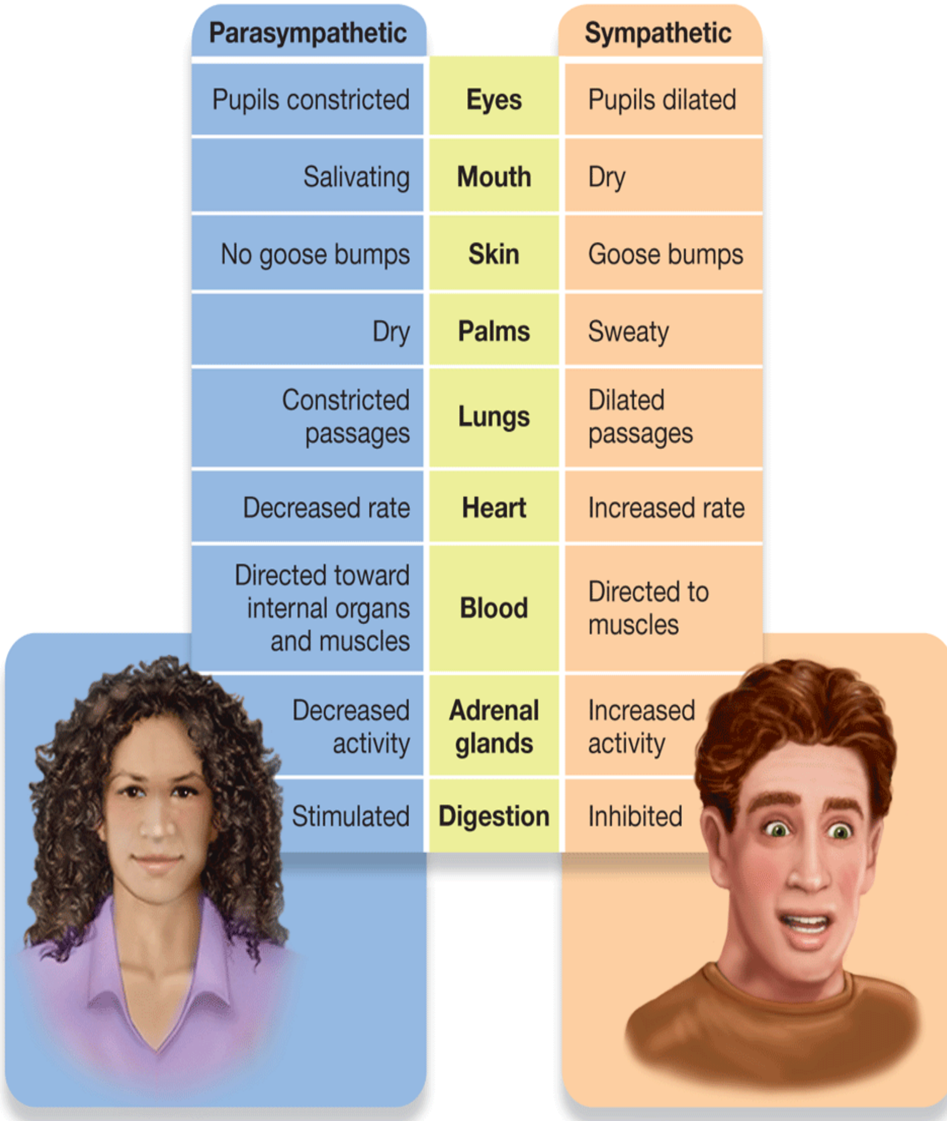
projections to other brain structures that lead to the observable behaviours that we think of as being emotional responses. When the amygdala receives input about a stimulus that might be emotionally meaningful or threatening, it sends feedback to sensory areas so that they fire more than they would for a non-emotional stimulus. So, when you see a spider or hear a dog growling, your amygdala will help to increase the activity in your visual and auditory cortices, respectively. The result is that we end up paying more attention to these potentially emotional stimuli. Sensory cortices and the amygdala continue to influence each other through these "feedback loops" throughout the emotional experience (Vuilleumier, 2005).

The Autonomic Response: Fight or Flight?

Listen to the Audio

An emotional response obviously involves more than simply perceiving a threat—we need to prepare our body to physically respond to the emotional stimulus, if necessary. Importantly, this preparation needs to occur instinctively and as rapidly as possible. The *autonomic nervous system* (ANS) specializes in such responses. As you read in Module 3.3, the ANS consists of two systems: (1) the *sympathetic nervous system*, which helps recruit energy to prepare you for a response (e.g., to fight or flee from a potential threat), and (2) the *parasympathetic nervous system*, which helps preserve energy and calms you down if no response is necessary (Figure 11.15). Think back to the example at the beginning of this module. If the moving object was a large and angry spider, the sympathetic nervous system would mobilize resources so that you had enough energy either to do battle with this threatening creature or to run away from it. If you discovered that you weren't in immediate danger (e.g., a moving object is a leaf, not a spider), the parasympathetic nervous system would become active in an attempt to return you to a normal level of emotional arousal.

Figure 11.15 The Autonomic Nervous System and Emotional Responding



The ANS is involved in emotional responding. The sympathetic division prepares the body to respond to stress, and the parasympathetic division restores the body to normal conditions.

The Emotional Response: Movement

Listen to the Audio

If your body is going to mobilize its energy resources during an emotional response, it also needs to plan for what it is going to do with them. In other words, the nervous system needs to prepare your body to make a movement in response to the emotion you are experiencing (e.g., jumping away from the spider). The problem for us is that even the simplest of movements requires the coordination of a number of parts of your nervous system so that the muscles move in the appropriate order. Research has found that emotional stimuli—particularly *threatening* emotional stimuli—trigger an increase in activity in brain areas related to planning movements (Pereira et al., 2010) and in several regions of the spinal cord (Smith & Kornelsen, 2011). This activity suggests that our nervous system is becoming prepared to make a movement if one is necessary—this preparation likely increases the speed and efficiency of our emotional responses.

Emotional Regulation

Listen to the Audio

As we saw in the example at the beginning of this module, it makes sense from a survival standpoint to have rapid emotional responses and *then* to decide if the responses are correct or not. However, this evaluative stage of emotional responses is the most complex and involves a number of areas within our frontal lobes. The frontal lobes receive information directly from the amygdala and from sensory areas whose activity is influenced by the amygdala. As a result, the frontal lobes have access to highly detailed information about a stimulus or situation as well as information about the initial responses of other brain networks. The frontal lobes must determine whether the instinctive emotional responses produced by earlier stages of processing are the best ones for that given situation. In some cases, the frontal lobes will analyze the situation and agree that an emotional response is necessary. It will then generate a behaviour that is appropriate for that situation (e.g., you should continue to run away from the spider). In other cases, the frontal lobes will analyze the situation and decide that a stimulus is not emotional (e.g., the moving object was just dust or a leaf, not a spider). In this case, it is necessary to decrease the emotional responses so that the ANS is not depleting the body's resources. So, in the first situation (running away from the spider), the amygdala and ANS influence the frontal lobes; in the second situation, the frontal lobes send feedback that reduces the intensity of the initial emotional response. This constant communication between brain regions is an important characteristic of our emotional system (Mayberg

et al., 1999) and explains why we can sometimes feel emotionally out of control and at other times feel "cool, calm, and collected."

Experiencing Emotions

Listen to the Audio

Try this: hold a pencil or straw in your mouth sideways without letting your lips touch it—just your teeth. Wait for a few seconds. How do you feel? Happy? Sad? Afraid? Why do you think you feel this way?

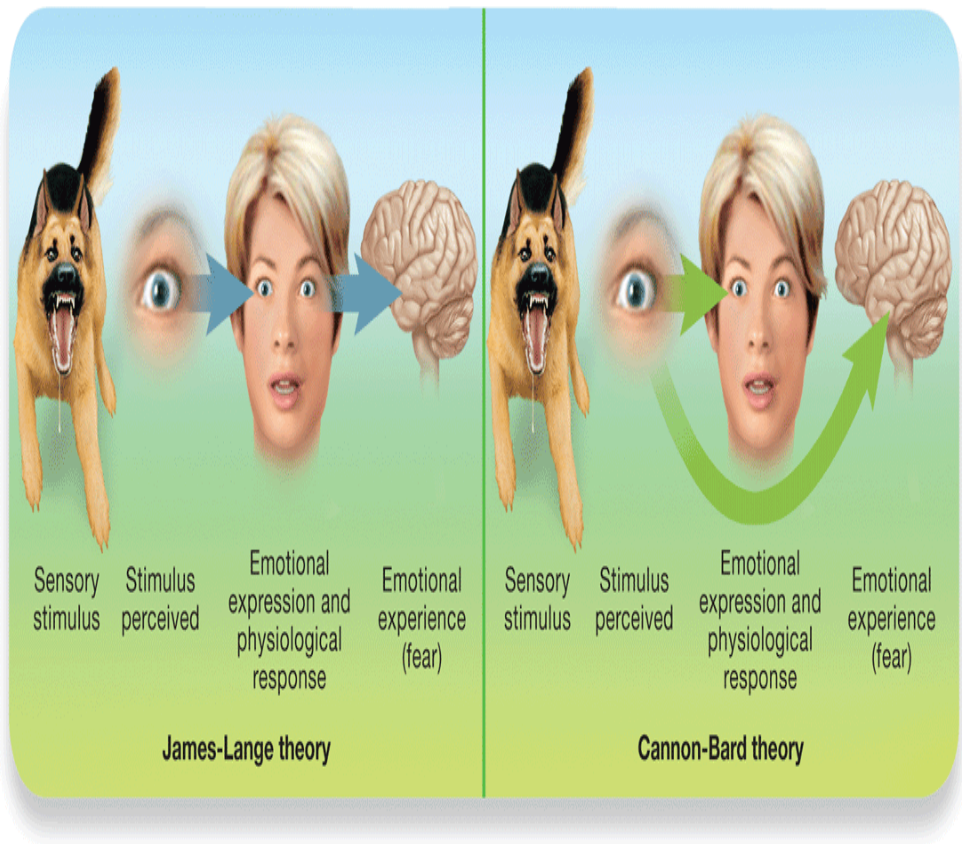
When we think of the term *emotion*, we rarely think about complex interconnected responses in our brains. Instead, we think of the subjective, personalized *feelings* that we experience such as happiness or fear. For example, we've already discussed how seeing an unidentified moving object in your bedroom can trigger activity in a number of physiological systems leading to the firing of millions of neurons in your brain and in the autonomic nervous system throughout your body. But you would think of that experience as a *feeling of fear*. How are the physiological response and the psychological feeling related? Which comes first and, importantly, how would you test this question?

The earliest scientific theory of emotions was independently developed by William James, one of the founders of psychology in North America, and a Danish researcher named Carl Lange. Now known as the **James-Lange theory of emotion**, *this view suggested that our physiological reactions to stimuli (e.g., a racing heart)* precede *the emotional experience (e.g., the fear)*. In other words, your subjective feelings such as happiness or fear follow your physiological responses. But the James-Lange theory goes one step further, claiming that your feeling of fear is *determined* by how your body responds. According to this theory, emotion would be

experienced in the following way: (1) based on your initial perception of a stimulus, your heart starts to race, (2) your brain receives feedback about that response, and then (3) the brain decides that based on the feedback it has received, you should feel fear. This sequence of events may contradict your own commonsense experience of emotion. If so, you are not alone. Some prominent researchers from the same era disagreed with James and Lange.

Walter Cannon and Philip Bard developed an alternative to the James-Lange theory (see Figure 11.16). They noted that some of the internal organs involved in emotional feelings could not respond quickly enough to be the first step in an emotional response. They also suggested that the feedback from the body was not specific enough to create the different emotions that we experience. Instead, the **Cannon-Bard theory of emotion** *suggested that the brain interprets a situation and generates subjective emotional feelings, and that these representations in the brain trigger responses in the body*. This theory suggests that these emotional processes occur very quickly, so that the steps occur almost simultaneously.

Figure 11.16 Competing Theories of Emotion



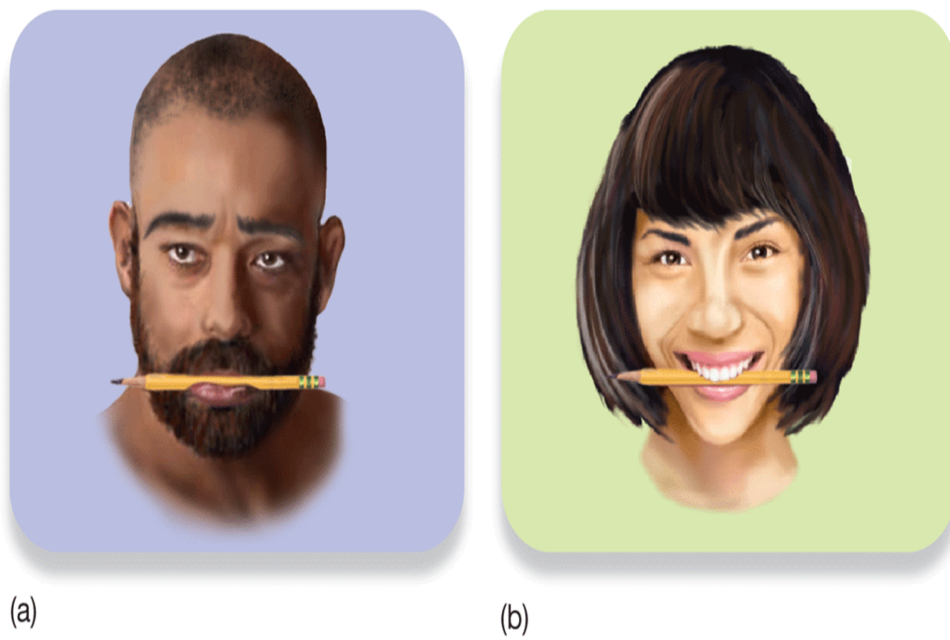
What is the correct order of events when it comes to emotional experiences? The James-Lange and Cannon-Bard theories differ in their predictions.

Source: Adapted from Dr. Silvia Helena Cardosa, **www.cerebromente.org.br/m05/mente/tub6.gif**.

For several decades, the Cannon-Bard theory was the most widely accepted view of our emotional behaviours. However, as clever researchers examined emotions in more detail, this "commonsense" theory began to show its limitations (another example of scientific knowledge evolving). In fact, there is more empirical support for the James-Lange theory than for the Cannon-Bard theory. This is likely due to the fact that some of the bodily feedback involved in emotional responses is caused by facial responses that have direct connections to the brain rather than by slow responses from internal organs. Indeed, the **facial feedback hypothesis** is a key feature in modern interpretations of the

James-Lange theory (see Figure 11.17). This hypothesis *suggests that our emotional expressions can influence our subjective emotional states*. So, if your lips are smiling, you will feel happier. Did you feel happier when you held your pencil or straw in your teeth a few minutes ago? Research participants who performed this action were essentially smiling whether they meant to or not. As the facial feedback hypothesis predicted, the participants reported elevated levels of happiness (Strack et al., 1988).

Figure 11.17 The Facial Feedback Hypothesis



Psychologists have found that inducing a facial expression, such as a frown or a smile, can have mild effects on how people feel. This lends support to the facial feedback hypothesis.

What is a potential alternative explanation for this result? If you tried this example in front of other people, the answer would become readily apparent: You look and feel silly. In order to rule out the possibility that making *any* artificial face would improve your mood, researchers had participants make a different facial expression. Hold the pencil sideways in your mouth using only your lips—don't let your teeth come into contact

with the pencil. The result is a slight pout. This is an experimental method of producing a sad face and, sure enough, it leads to a less positive mood (Larsen et al., 1992).

However, the facial feedback hypothesis is not supported by all studies (Wagenmakers et al., 2016). An examination of several previous studies found that facial feedback effects are reproducible, but not as powerful as was previously believed (Coles et al., 2019). Therefore, although biological responses are *part* of our emotional experiences, there must be other factors that affect how we feel.

Working the Scientific Literacy Model

The Two-Factor Theory of Emotion

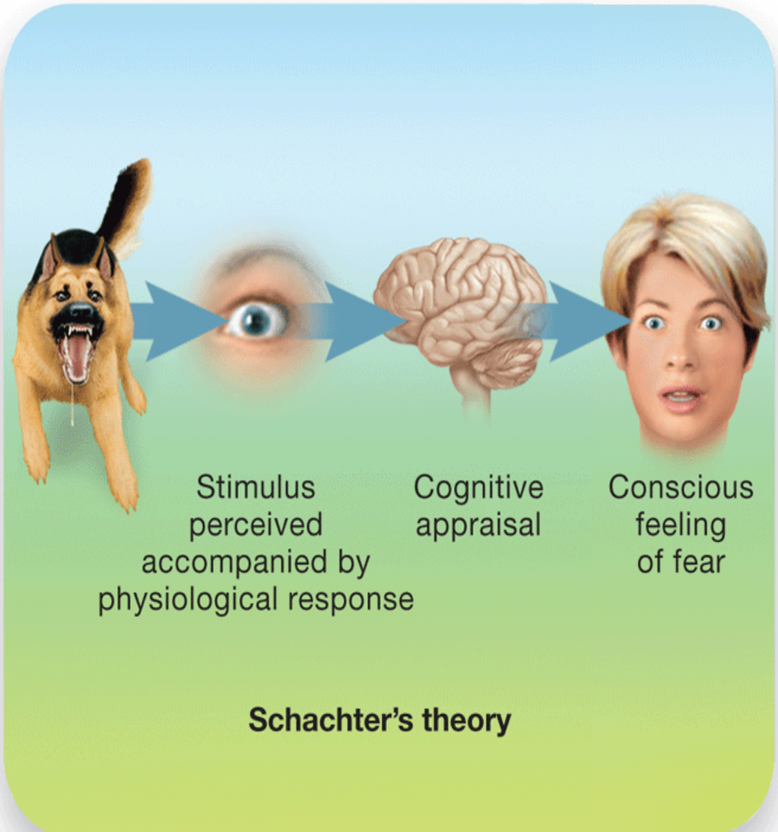
Listen to the Audio

To this point, our discussion of emotions has focused on physical reactions. However, our emotional feelings also involve thoughts, memories, beliefs, and interpretations of different stimuli and situations. How do these different factors interact to produce our emotional experiences? In the 1960s, two researchers developed a theory of emotion that addressed this question.

What do we know about the two-factor theory of emotions?

Researchers Stanley Schachter and Jerome Singer (1962) agreed with James and Lange that our physical reactions give rise to our emotional experiences. However, they also pointed out that many emotions can elicit physiological arousal. How do we choose which emotion goes with this arousal? Schachter and Singer suggested that it is our interpretation of *why* we are aroused that creates the emotional experience. Their theory, the **two-factor theory**, *holds that patterns of physical arousal and the cognitive labels we attach to them form the basis of our emotional experiences*. Physical arousal is the first factor to come into play (as James and Lange predicted) and along with this comes a cognitive label for the experience, such as "I am sad." Combining the two factors, the physical and cognitive, gives rise to the emotional experience of sadness (see Figure 11.18).

Figure 11.18 Two-Factor Theory of Emotion



According to Schachter and Singer, emotions are experiences composed of physiological responses and the cognitive labels we give them.

How can science explain the two-factor theory?

To test this theory, Schachter and Singer performed a study in which participants were given different cognitive labels for the same physical feeling. These researchers injected three groups of volunteers with adrenaline (epinephrine), a stimulant that increases a person's heart rate, causes sweating, and makes a person's face feel warm and flushed. So, all participants

experienced the same physical symptoms. However, the cognitive explanation for those symptoms was manipulated by the experimenters. The experiment consisted of four groups:

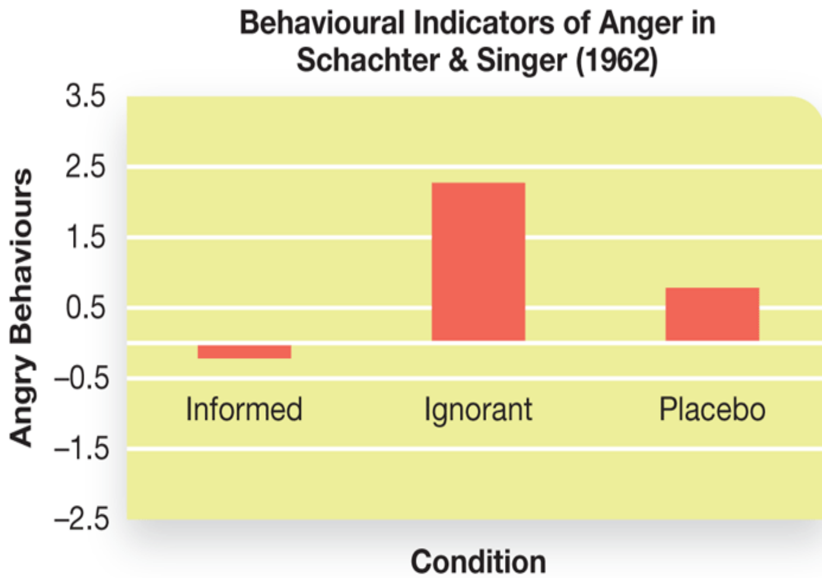
- *Informed Group:* These participants were correctly informed about the cause of the physical symptoms.
- *Ignorant Group:* These participants were not given information about the cause of the physical symptoms.
- *Misinformed Group:* These participants were given incorrect information about the injection; they were told that adrenaline leads to numbing, itchiness, and a slight headache.
- *Control Group:* These participants were injected with a saline solution and therefore didn't experience physical symptoms.

Thus, only the Informed Group had a correct cognitive explanation for their physical feelings. The experimenters then had each participant sit in a room with another participant who, in reality, was an actor paid to create an emotional scene. In one version of the study, the experimenters told the participants that they would have to wait for 20 minutes before receiving a vision test, and that they could doodle on the papers left in the room. After the experimenter left the room, the actor began to behave in an excited fashion, playing basketball with crumpled-up paper and playing with props that had been left in the room (e.g., hula-hoops). In other words, the actor was behaving euphorically (extremely happily). In another version of the study, participants were asked to fill out questionnaires during the 20-minute delay period. The questions were quite personal in nature, and oftentimes mildly offensive (e.g., "With how many men [other than your father] has your mother had extramarital relationships?

4 and under, 5–9, 10 and over"). After reading these questions, the actor became quite angry and tore up the sheet of paper while swearing.

The question the experimenters wanted to answer was whether the participants' responses to the actor were affected by the cognitive explanation they had been given for the effects of adrenaline. Presumably, if you knew that you were going to have your heart rate increase due to a drug, then you would attribute any changes in your heart rate to the drug, not to the actor. In contrast, if you didn't know about the effects of adrenaline, then you would assume that your heart was racing because you were having an emotional response to the actor. As predicted, in both the euphoria and the anger conditions, the participants' emotional responses were influenced by their ability to explain their physical symptoms. When people understood the adrenaline was going to make their heart race, they reported smaller emotional reactions to the actor than when they were ignorant of the drug's effects (see Figure 11.19). This classic study provided the first evidence that our cognitive interpretation of an emotional event can have a dramatic effect on how we experience that situation. In the process, it showed a limitation of the James-Lange theory. That theory would assume that the emotional experience (anger or euphoria) would be due to different physiological causes. Instead, the same physiological stimulus—adrenaline—led to different emotional responses in the two experimental conditions.

Figure 11.19 Results from Schachter and Singer's Study



If participants knew that their racing heart was due to a drug injected by the experimenter, their emotional responses to the actor in the study were smaller. This graph depicts the number of angry statements and acts performed by participants in the angry condition of the experiment.

Source: Graph based on Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review, 69*, 379–399. Table 5, p. 392.

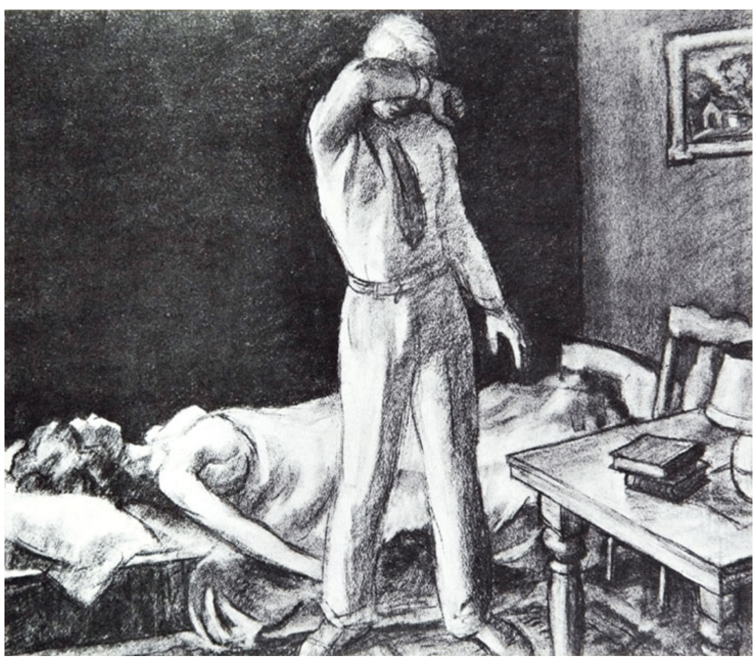
Can we critically evaluate these findings?

One criticism of Schachter and Singer's experiment is that it might not apply to the real world. Very few of us are given injections of adrenaline and made to watch someone acting in an emotionally extreme manner. In order to test the generalizability of these results, Donald Dutton and Arthur Aron (1974) from the University of British Columbia performed an innovative experiment that provided strong support for the two-factor theory. In this study, a female experimenter told male participants that she was investigating the effects of scenic attractions on creative expression. Participants were asked to cross a bridge before completing the Thematic Apperception Test, an open-ended test in which participants create stories to go

along with a set of pictures. The independent variable of this study was the bridge the participants crossed. In the control condition, individuals crossed a solid wooden bridge that was approximately 3 m above a small, shallow stream. In the experimental condition, individuals crossed the Capilano Canyon Suspension Bridge, which, as the name would suggest, crosses the Capilano Canyon near Vancouver. This bridge is 120 m long, hangs 75 m above rocks and rapids, and has a tendency to sway, which can create the impression that one is about to fall over the edge. Needless to say, the experimental condition would produce greater levels of emotional arousal. Interestingly, participants who were in the experimental condition included significantly more sexual imagery in their stories than did participants in the control condition. The explanation for this result is that the participants experienced stronger emotions when crossing the suspension bridge, but misattributed the arousal to the pictures.

Stronger support for this explanation came from an interesting addition to the study. After the participants had completed the Thematic Apperception Test, the female experimenter tore off a sheet of paper and wrote down "her number" (a fake phone number set up by the experimenters). Only 12.5% of the control participants phoned the woman's number; 50% of the experimental participants phoned the same woman. When participants experienced emotional arousal, they interpreted it as attraction to the experimenter. Keep this result in mind the next time someone wants to take you to a scary movie for a first date.

Bill Aron/PhotoEdit, Inc.



Bill Aron/PhotoEdit, Inc.

An example of the Thematic Apperception Test stimuli used in the Capilano bridge experiment. Males in the high-arousal condition produced stories that included more sexual imagery than did participants in the control condition.

Why is this relevant?

Studies of the two-factor theory of emotions show us that although we do have rapid physiological responses to emotional situations, it is our *interpretation* of those events that leads to our emotional experiences. This obviously doesn't mean that you will never be upset. But knowing that you *can* control how you interpret some of the emotional (or even the aggravating day-to-day) events of your life means that you can try to reduce the negative effects that emotional situations can have on you.

Expressing Emotions

Listen to the Audio

Are you a good liar? Can you tell when someone else is lying to you? How confident are you in your lie detection abilities? Although most of us believe we are quite good at spotting someone else's deception, the truth is that our accuracy is quite poor. In order to fix this problem, researchers attempted to create a lie detector test that measured the responses of our autonomic nervous system. This machine, a *polygraph*, measures whether heart rate and sweating increase when a person responds to different events or questions. Sudden changes in these levels suggest that the person is experiencing stress and may be hiding something. However, after extensive testing, the polygraph was shown to be an inaccurate measure of lie detection. Evidence gathered using this technique is not admissible in Canadian courts.

Fortunately, psychologist Paul Ekman and his colleagues (1999) have developed a new technique for lie detection. Using videotapes of several research participants, Ekman and colleagues found that our faces give us away when we try to lie. Although we can fake an emotional expression within a fraction of a second, our real emotional response can be seen on our faces before this mask is in place. Ekman called these brief expressions of our true feelings *microexpressions*, and is training police officers to detect them in order to catch criminals. But use your critical-thinking skills for a moment: What do microexpressions really tell you? Yes, the face is expressing someone's inner state, and yes, it appears that a person is concealing how they are feeling. But microexpressions cannot

tell you *why* they are doing so. Instead, police officers have to make assumptions about the person's motives based on the microexpressions on their face.

The meaning behind facial expressions changes with subtle modifications. For example, one version of smiling is genuine, while another is reserved for social graces. Genuine smiles, known as *Duchenne's smiles*, involve a crinkling of muscles at the corner of the eye. Fake smiles tend not to have this crinkling (unless you practise, which is mildly creepy). However, even if you learn to fake your emotions, your face can give you away. Psychologist Paul Ekman (pictured above) has shown that our real emotional responses appear on our faces for a fraction of a second before being covered up with our social mask.

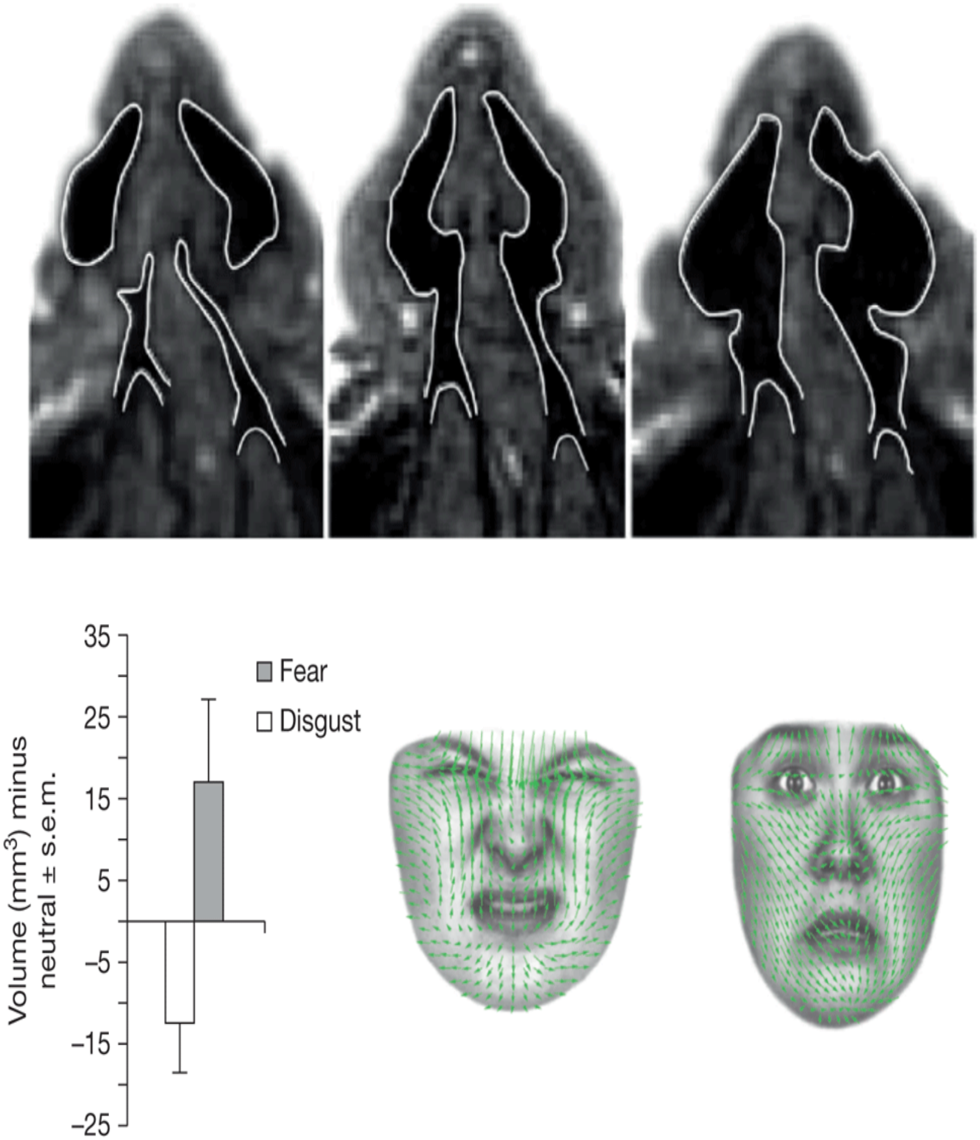
This all sounds very dramatic, but we make assumptions about other people's feelings and motives all the time. It is quite rare for someone to tell you exactly how they feel. Instead, you observe other people's faces and body movements in order to make an educated guess about what thoughts and feelings are going on inside their heads. They, in turn, do the same with you. In this section of the module, we will examine these processes, as well as how culture can influence how emotions are expressed and interpreted.

Emotional Faces and Bodies

Listen to the Audio

Our primary method of communicating our emotional feelings is through our facial expressions. Each of these expressions has its own unique combination of muscle movements, such as the crinkling of muscles near the eye (*orbicularis oculi*) and the movement of the mouth (*zygomatic major*) during smiling. But why are certain combinations of muscle movements associated with particular feelings? Although researchers are still trying to solve parts of this puzzle, researchers at the University of Toronto have highlighted some important characteristics of expressions of fear and disgust. Imagine changing a really stinky diaper. The powerful odour feels like it's crawling up your nostrils. Your natural reaction is to make a disgusted face, which involves scrunching up your nose. This expression isn't just for show, however. It also reduces airflow into your nostrils, thus limiting the amount of the disgusting substance(s) that can enter your body (Chapman et al., 2009; Susskind & Anderson, 2008). This reaction makes evolutionary sense, as some disgusting substances could threaten a person's health. In contrast, when we experience fear, our eyes open wide and we tend to inhale deeply (see Figure 11.20). This is likely due to the fact that when we're afraid, we are being threatened and therefore need to be able to take in as much information as possible in order to develop the best plan of action to keep ourselves safe. These results show that the strange facial geometry that makes up our emotional expressions is not random—our expressions have a purpose that will enhance our ability to survive (Shariff & Tracy, 2011).

Figure 11.20 Nostril Airflow Associated with Disgust and Fear



The images depict the opening of nasal passageways during the experience of disgust (left), a neutral emotion (centre), and fear (right). Note that the passageways are constricted during disgust, but opened wider during fear. This difference is reflected in the volume of airflow breathed in during each facial expression.

Source: Susskind, J. M., Lee, D. H., Cusi, A., Feiman, R., Grabski, W., & Anderson, A. K. (2008). Expressing fear enhances sensory acquisition. *Nature Neuroscience*, *11*(7), 843–850. Top image is Fig. 6c, p. 846; bottom-left image is Fig. 5b, p. 846; bottom-right image is Fig. 2a-b, p. 844.

Importantly, these expressions appear all over the world, suggesting that they are an innate part of being human. Charles Darwin (1872) was the first person to recognize that some facial expressions of emotion were universal. During his extensive travels, he noted that people from different cultures formed similar facial expressions and were able to understand the emotions of others. In the late 1960s, Paul Ekman performed cross-cultural studies that supported Darwin's hypothesis. Ekman and his colleagues photographed North Americans expressing six basic emotions—fear, happiness, disgust, anger, surprise, and sadness. They then travelled to an isolated region of Papua New Guinea (an island country north of Australia) to see if individuals who were unfamiliar with Caucasian faces could still recognize the emotions they displayed. Sure enough, tribesmen from the Fore ethnic group were able to accurately identify the emotions of the actors (Ekman & Friesen, 1969). The researchers then asked the tribesmen to make their own facial expressions for each emotion. As would be expected, research participants in the United States were also able to recognize these emotions.

Individuals in isolated areas of the world were able to identify the emotions expressed by these faces, suggesting that these expressions are universal.

Paul Ekman Group, LLC

But facial expressions aren't our only way of communicating our emotional states. Imagine that you are sitting across a table from someone that you find attractive. Or what if you found the person annoying and really wished your friend would return from the washroom so that you could leave? Even if you didn't express any emotion with your face, your body would likely give away what you were feeling in both situations. *Body language* provides almost as much emotional information as facial expressions; it also activates a number of similar brain areas (de Gelder & Hadjikhani, 2006). Researchers at Queen's University have

created a novel method of examining body language and biological motion. Experimental stimuli are created by attaching motion capture sensors to different parts of people's bodies and having them make different movements such as walking. By averaging the types of movements across a number of individuals, it is possible to see the different body movement patterns of men and women, happy and sad people, and nervous or relaxed people (Troje 2002a, 2002b, 2008). Importantly, like the recognition of faces, detecting characteristics of body language and body motion appears to be universal, as many of the effects were observed in the Munducuru indigenous people in Amazonian regions of Brazil (Pica et al., 2011).

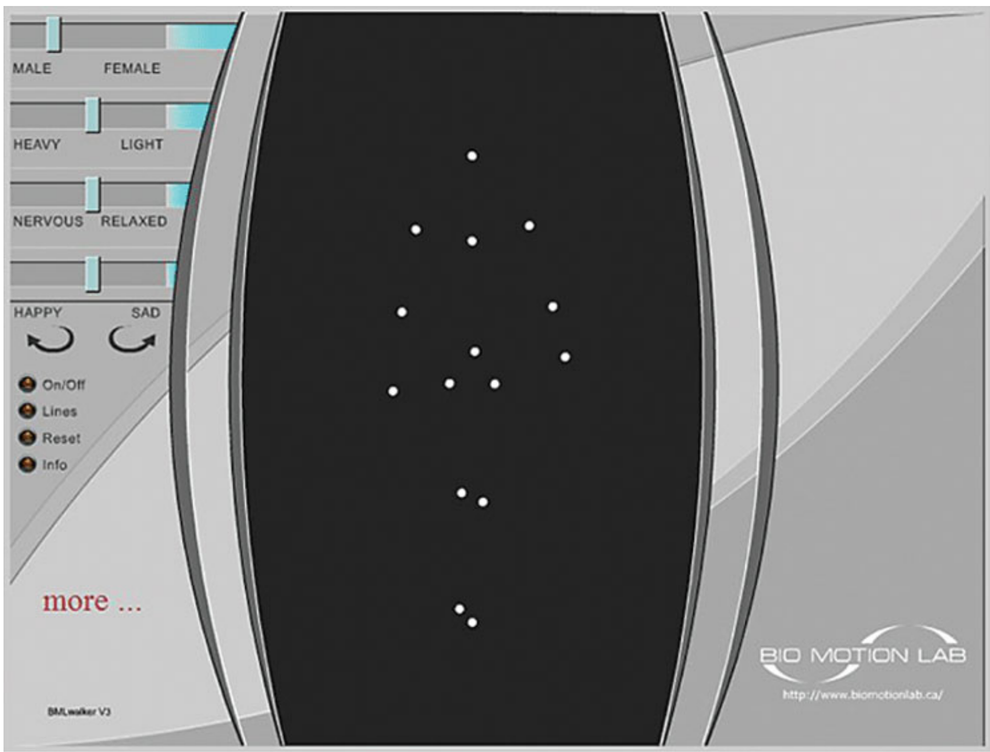
Culture, Emotion, and Display Rules

Listen to the Audio

Despite the universality of many aspects of emotion, people raised within a specific culture show characteristics that are specific to their region (Elfenbein & Ambady, 2003). Put simply, cultural groups have unique **emotional dialects**, or *variations across cultures in how common emotions are expressed*. For example, people from North America and from Gabon (a country in West Africa) both experience contempt. However, North Americans are more likely to lower their brow, and Gabonese people are more likely to raise their upper lip when expressing this emotion.

The situation or context is a major factor in determining when members of different cultures express specific emotions. **Display rules** *refer to the unwritten expectations we have regarding when it is appropriate to show a certain emotion*. Think about embarrassing situations. In North America, we tend to blush and look away when embarrassed. In Japan, on the other hand, people tend to smile. They aren't happy, but do their best not to show embarrassment. Indeed, numerous studies have documented differences in display rules between North American and Japanese individuals, often highlighting interesting and subtle differences. For instance, imagine seeing someone displaying a highly intense emotion such as a very happy face. You would probably assume that their internal state was just as joyous as their face. Now, imagine that you see someone expressing a low-intensity expression (e.g., a smile that is only 50% as powerful as normal). How do you think that person is feeling? David Matsumoto and his colleagues (2002) noticed that while American and

Japanese participants agreed about the person's emotional state when viewing high-intensity emotions, they differed when the emotions were less intense. American participants assumed that the person was feeling the emotion less strongly. Japanese participants, on the other hand, assumed that the person felt the emotion strongly, but wasn't in a position to outwardly express that intensity. In other words, the Japanese participants were assuming that the person being photographed was obeying particular display rules that limited his or her expressiveness (Matsumoto et al., 2002).



Point-of-light technology can be used to infer a number of characteristics from a person's biological motion, including his or her emotional state. See www.biomotionlab.ca/Demos/BMLwalker.html.

Source: Troje, N. F. (2002) Decomposing biological motion: A framework for analysis and synthesis of human gait patterns. *Journal of Vision, 2*, 371–387. URL: www.biomotionlab.ca/Demos/BMLwalker.html. Prof. Dr. Nikolaus Troj/Biomotion Lab/Queen's University
Prof. Dr. Nikolaus Troj/ Biomotion Lab/Queen's University

Culture-specific display rules such as these can be found the world over and show us that we need to be cautious about over-generalizing the meaning of different displays of emotions (Elfenbein et al., 2007). It remains to be seen whether the worldwide use of programs like Facebook, Snapchat, and Instagram will reduce cultural differences in display rules.

Although it may seem like cultural display rules are fairly stable, they can vary over time. A recent examination of American high school yearbook photos shows how cultural expectations can influence how we express ourselves (Ginosar et al., 2015). Researchers collected over 37 000 high school photographs and used computers to create "average photos" for males and females in each decade since 1900. As you can see in Figure 11.21, students at the turn of the twentieth century were expected to remain quite serious, whereas students from the current decade (i.e., most of the readers of this book) were encouraged to smile happily (or to fake it convincingly). In fact, if you take a trip to the portrait gallery of any art museum, you'll see that smiling when being photographed or painted has only become commonplace in the past 50 years. This shows us that our point in history, as well as our location on a map, can have a large effect on our emotional display rules.

Figure 11.21

Averaged Photographs of Male and Female High School Students from 1900 to the Present Decade

Why do you think people are more emotionally expressive now than they were 100 years ago? There are a number of possibilities, ranging from world events, to financial stability, to how familiar (and comfortable) people were with being photographed.

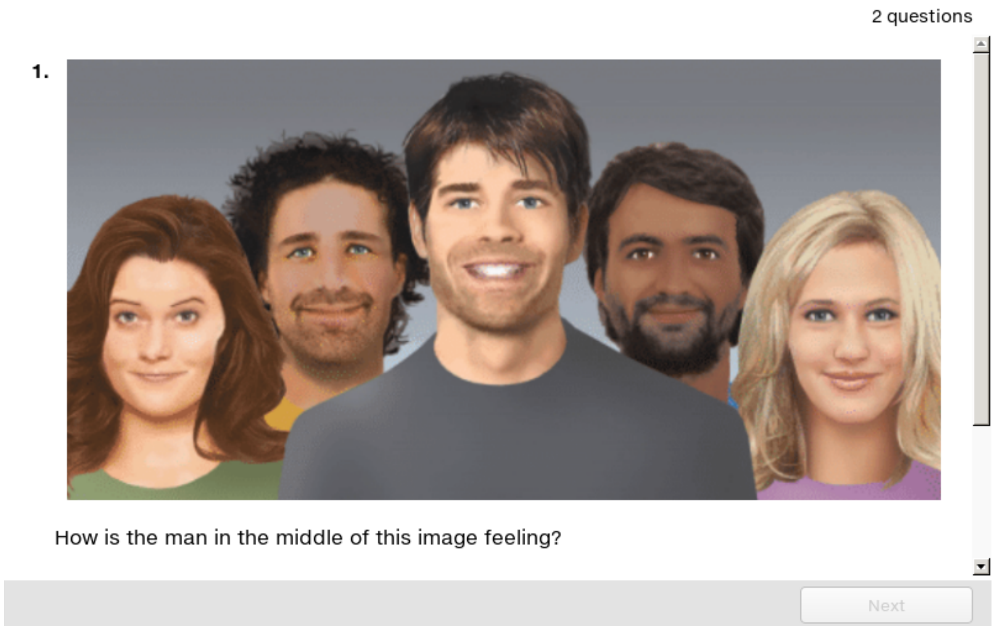
Source: Ginosar, S., Rakelly, K., Sachs, S., Yin, B., & Efros, A.A. (2015). *A century of portraits: A visual historical record of American high school yearbooks*. Fig. 1 from Extreme Imaging Workshop, International Conference on Computer Vision, ICCV.

Culture, Context, and Emotion

Listen to the Audio

Understanding another person's emotional state can also be influenced by the context in which that emotion is being displayed. Importantly, the role that context plays in the interpretation of others' emotions varies across cultures. Some cultures (e.g., Western countries) focus on the person expressing the emotion. People in other cultures (e.g., Asian countries) tend to also pay attention to those *around* the person expressing that emotion. So, do these different ways of looking at a situation translate into differences in how people of various cultures interpret emotions? To answer this question, psychologists asked students from both Western and Asian universities to judge the emotion of the central figure in the scenes depicted in Figure 11.22. Western students tended to focus on the facial expression of the central figure. Thus, if the individual was smiling, they would report he was happy, and they did not interpret his happiness with respect to how the surrounding people appeared to feel. In contrast, Asian students interpreted the central figure's emotion in reference to what people in the background might be feeling (Masuda et al., 2008). So, in the right panel of Figure 11.22, a Westerner might report that the central figure was happy, while an Asian person might assume that the central figure was happy at the expense of the other people.

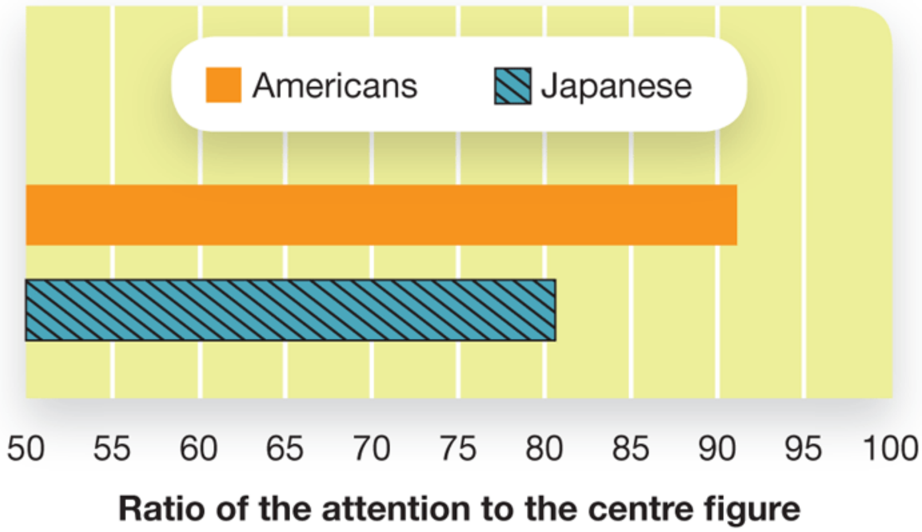
Figure 11.22 How Is the Man in the Middle of These Pictures Feeling?



Source: Based on Masuda, T., Ellsworth, P.C., Mesquita, B., Leu, J., Tanida, S., & van de Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. Journal of Personality and Social Psychology, 94, 365-381.

The tendency for Asian students to focus on people in the background was further confirmed in two ways. First, Asian students were more accurate than Western students in remembering whether they saw specific individuals in the background. Also, using a device that tracks the eye movements of the participants, the researchers discovered that Asian students spent more time actually looking at the entire picture, rather than just the central character (Figure 11.23; Masuda et al., 2008). Interestingly, a subsequent study found that Canadian-born students with Asian ancestry acted more like North American participants than Japanese participants (Masuda et al., 2012). Together, these experiments show us that although the perception of emotional expressions is universal, the interpretation of why those expressions are being displayed is very culture-dependent.

Figure 11.23 East–West Differences in Interpreting Emotion



In comparison to Asian people, Westerners spend more time looking at the focal individual in a scene and interpret his or her emotions without reference to surrounding individuals (Masuda et al., 2008).

Source: Based on Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & van de Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. *Journal of Personality and Social Psychology*, *94*, 365–381. URL: https://sites.ualberta.ca/~tmasuda/index.files/MasudaEllsworthMesquitaLeuTanidavandeVeerdonk2008.pdf

Module 11.4 Summary

Listen to the Audio

11.4a Know . . . the key terminology associated with emotion.

Review Module 11.4

Start Over Swap

0/8 REVIEWED · 0 MASTERED

James-Lange theory of emotion

Previous Next Got It!

11.4b Understand . . . how the nervous system responds to emotions.

Our biological responses to emotions occur in many different parts of our nervous system. Our brain has a rapid-response system involving the amygdala, which can fire within a few hundred milliseconds. This system

triggers activity in other brain areas and influences how much attention a stimulus will receive. Our sympathetic nervous system also responds quickly. Soon after, brain and spinal cord areas related to movement become active in order to prepare us for a response. Finally, frontal lobe regions examine the situation to determine whether we should continue the emotional response or change our behaviour to conserve energy.

11.4c Understand . . . cultural similarities and differences in emotional expressions.

Emotions such as fear, anger, happiness, sadness, surprise, and disgust appear to be human universals—all people experience them regardless of culture. At the same time, we cannot completely explain human emotions without references to cultural variation in the form of dialects and display rules.

11.4d Apply . . . your knowledge of theories of emotion to new examples.

Apply Activity

Try this exercise. Spend 10 seconds looking at the Sanskrit figure on the left in Figure 11.24 while slowly nodding your head. Now, spend about 10 seconds looking at the figure on the right while slowly moving your head from side to side.

Figure 11.24 Application of Emotion Theories

Now, imagine that you had to choose one image to display on the wall of your home. Which one would you choose—the one on the left or the one on the right?

What is important about this exercise is not which figure you chose. Rather, it is the application of emotion theories to the problem. Consider the facial feedback study, and try to explain how the head movements could potentially influence one's preference for a symbol. This module provided examples of what researchers have found using similar techniques.

11.4e Analyze . . . what purpose(s) facial expressions serve?

Facial expressions allow us to show the outside world what we are feeling. But they serve other functions as well. For instance, facial expressions of disgust actually restrict the amount of air entering the body, possibly to protect us from contaminants. Expressions of fear serve to increase the amount of sensory information available to us, thus

helping us to select the most appropriate response to that stimulus or situation.

Chapter 12
Personality

Listen to the Audio

12.1 Contemporary Approaches to Personality

- Idiographic vs. Nomothetic Approaches
- Beyond the Big Five: The Personality of Evil?
- Personality Traits over the Lifespan
- Working the Scientific Literacy Model: Right-Wing Authoritarianism at the Group Level
- Behaviourist and Social-Cognitive Perspectives
- Module 12.1 Summary

12.2 Cultural and Biological Approaches to Personality

- Culture and Personality
- How Genes Affect Personality
- Working the Scientific Literacy Model: From Molecules to Personality
- The Role of Evolution in Personality
- The Brain and Personality
- Module 12.2 Summary

12.3 Psychodynamic and Humanistic Approaches to Personality

The Psychodynamic Perspective

Working the Scientific Literacy Model: Perceiving Others as a Projective Test

Alternatives to the Psychodynamic Approach

Module 12.3 Summary

Module 12.1 Contemporary Approaches to Personality

Listen to the Audio

Pearson Education

Learning Objectives

12.1a Know . . . the key terminology associated with contemporary approaches to personality.

12.1b Understand . . . the behaviourist and social-cognitive views of personality.

12.1c Apply . . . self-report methods to understand your own personality.

12.1d Analyze . . . the personality roots of violence and prejudice.

12.1e Analyze . . . the relative roles of personality traits and psychological and physical states in determining behaviour.

What does your living space say about you? That alphabetized bookshelf and bathroom full of grooming products suggest conscientiousness. The photos of Mount Everest and major European cities reveal an openness to experiencing new and exciting things. The three pet cats and tall shelves full of books? Possibly signs of an introverted homebody.

It might sound like we are just making assumptions here, but scientific research backs up the notion that personality can be measured by examining the details of our dwellings. Psychologist Sam Gosling and his students have, with permission, closely scrutinized people's offices and bedrooms for clues about their personality (Gosling, 2008; Gosling et al., 2002). Teams of seven or eight observers entered people's bedrooms and offices and rated the personality types of the occupants with a standardized personality test. Not only did the observers reach close consensus on many measures of personality, but their ratings also matched up with how the occupants rated their own personality. In addition to our living spaces, our "digital traces," comprising our online activity, can similiarly be used by others to provide relatively accurate personality assessments (Hinds & Joinson, 2019).

> *If you look around your own room, some parts of it may symbolize the "core" of who you are, whereas others reflect less "deep," more superficial details about yourself. For example, your book collection and most treasured belongings may be very revealing, but what about the clothing strewn all over the floor? Does it mean that you are a lazy slob? Or that you are ambitious and live a busy life? Or simply that you are enjoying the freedom of not living with your parents? Which is more appropriate as an explanation: the dispositional (i.e., rooted in the kind of person you are) or the situational (i.e., external, circumstantial factors)? A key challenge for personality psychologists is figuring out how our personalities and circumstances work together in shaping our behaviour. This raises some important questions that we will address in this module.*

When you say to your friend, "Yeah, our date was okay, but you know, they weren't my kind of person," we understand that "my kind of person" means something. We accept that the person being described is some "kind of person"—that they have regular patterns and ways of being. What you are referring to is that individual's **personality**; their *characteristic pattern of thinking, feeling, and behaving that is unique to each individual, and remains relatively consistent over time and situations*. Psychologists have long searched for a theory of personality that can describe and explain how people develop these patterns, because we all want to find out what "kind of person" we are.

Idiographic vs. Nomothetic Approaches

Listen to the Audio

If there are semi-stable patterns that differ from person to person, how can we measure those patterns? This quest to shine the light of science on the very nature of our own selves has resulted in two broad approaches to personality measurement: the *idiographic approach* and the *nomothetic approach*.

When you try to figure out the people you know very well, you probably intuitively adopt an **idiographic approach**, focusing on *creating detailed descriptions of a specific person's unique personality characteristics*. So, imagine you are writing a few paragraphs to nominate a favourite professor for a leadership award. You might build a theory of the way that they are, the way their personal experiences or their work history has affected them, and the idiosyncrasies that make them do the special things they do. In doing so, you are taking an idiographic approach, although an intuitive rather than scientific one. Sometimes we see the idiographic approach taken to help us better understand a single, influential person. For example, psychologists used a variety of biographical, interview, and archival methods to describe the personality of B. F. Skinner, the eminent behavioural psychologist discussed in Module 6.2 (Overskeid et al., 2012). He was what you might expect from a dedicated professor and scientist: highly motivated, detail-oriented, and fascinated by questions of science and philosophy. Surprising was the discovery that he was charming and had a good sense of humour, which is not something that came across very well in

photographs and caricatures of a man in a white lab coat spending his days watching pigeons peck for grain.

Idiographic approaches can be used to examine the full range of human experience, from the most disturbed to the healthiest and most highly functioning individuals. For example, criminal profilers may focus on a detailed study of a serial killer in order to help police in their investigation. At the other extreme, Abraham Maslow wanted to understand the people who had lived up to their fullest potential, who were, in Maslow's terms, "self-actualized." Accordingly, Maslow performed detailed analyses of the biographies of famous people who were widely regarded as being wise and fully functioning (Maslow, 1970). Maslow's findings launched decades of work trying to uncover what makes human beings thrive and develop to their maximum potential.

In contrast, psychologists who take a **nomothetic approach** *examine personality in large groups of people, with the aim of making generalizations about personality structure*. Rather than trying to understand a specific person, psychologists taking a nomothetic approach may want to understand what personality factors, or traits, are relevant to understanding people in general. For example, the concept of *extraversion* is a nomothetic trait because it can be used to describe everyone; any given individual will be somewhere between not at all extraverted to extremely extraverted, and most of us will be somewhere in the middle. Psychologists have identified many of these traits so, now, they can use traits for nomothetic research questions. For example, wanting to know whether a certain "type" of person is more likely to exhibit a certain behaviour pattern (e.g., are people who are extraverted more likely to develop attentional disorders?) is a nomothetic question. Answering a question like this requires measuring some specific variable (e.g., extraversion) and examining whether it correlates with specific outcomes (e.g., attentional disorders). The key to nomothetic research is to identify

the important personality traits that are related to whatever it is that you are interested in understanding.

Review Measuring Extraversion

Take a moment to measure your extraverted qualities. Please indicate the degree to which you agree or disagree with each statement as it applies to you.

1. I feel comfortable around people.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

2. I have little to say.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

Previous Next

Source: International Personality Item Pool. http://ipip.ori.org/newNEOKey.htm#Extraversion.

There are many examples of nomothetic research in Canadian universities. Dr. Gordon Flett at York University has examined personality predictors of alcohol, drug use, and depression in university students (e.g., Flett et al., 2009; Goldstein et al., 2009; Goldstein & Flett, 2009). Lawrence Walker at the University of British Columbia has sought to identify the "moral personality," seeking the personality factors that predict courage and heroism (Walker & Frimer, 2007; Walker et al., 2010). Jacob Hirsh at the University of Toronto has examined the personality predictors of pro-environmental motivations (Hirsh, 2010; Hirsh & Dolderman, 2007). Taking a nomothetic approach allows

psychologists to examine what types of people are more or less likely to engage in certain behaviours, which is an important step toward being able to reduce undesired behaviours or more effectively promote desired ones.

The Trait Approach

Listen to the Audio

What kind of person are you? Take a moment to complete the sentence "I am . . ." a few times. Now take a look at your list. If you're like most people, your list probably has quite a few personality traits, many of which have contrasting terms—words *like extraverted or introverted, funny or serious, ambitious or lazy, or perhaps anxious or easygoing*. A **personality trait** describes *a specific psychological characteristic that makes up part of a person's personality*; how that person is "most of the time." Trait descriptors are useful as shortcuts to understanding people. Traits summarize a great deal of information about a person and help to predict how that person will behave across a range of situations. For example, an "extraverted" person is more likely to be comfortable in social situations, go to parties, and have a large number of friends than someone who is "introverted."

Early Trait Research

Listen to the Audio

As you can imagine, many different traits could be used to describe people, such as “shy,” “cheerful,” “outgoing,” and “adventurous.” The first systematic attempt to identify all possible traits (in the English language) was made in the 1930s by Gordon Allport, who tallied nearly 18 000 English words that could be used to describe an individual’s physical and psychological attributes (Allport & Odbert, 1936). (Based on this limited evidence, we wonder whether Allport himself would be described as “patient,” “methodical,” and “weird to talk to at a party.”) Allport then developed a theory of personality structure by organizing these words into traits, launching a strong trend in personality psychology that continues to this day—attempting to identify and measure the key personality traits.

To accomplish this, trait researchers have devised many types of personality “scales.” Some, like the ones used in psychology research and described later in this chapter, are rigorously evaluated. Others, like the ones you find in popular magazines, are of questionable value. For example, *Cosmopolitan* regularly includes personality scales in which you can discover all sorts of things about yourself; while it is possible that *Cosmo* has a team of highly qualified psychologists rigorously designing these scales, we do not recommend that you base your life decisions on your results in the “Are You Enough of a Bad Girl?” quiz.

It is clear that people love to know what "kind" of person they are. However, it is often easier to make people *believe* that you are measuring their personality than it is to actually measure it. In fact, it is remarkably easy for people to be convinced that a personality profile describes them well. This can occur even when the profile is patently false and was not generated to describe them at all. This phenomenon is popularly known as "the Barnum effect," after the circus showman P. T. Barnum, due to his apparent statement "there's a sucker born every minute." (Ironically, P. T. Barnum never actually said this quote, which is widely attributed to him [Saxon, 1989].) The Barnum effect hearkens back to the late 1940s, when psychologist Bertram Forer gave research participants a personality test and then generated a personality description that subjects believed was based on their test responses. Even though all participants were given exactly the same personality description, they found the profile to be highly convincing and descriptive of them as an individual. When asked to rate how well the profile described them, on a scale ranging from 0 (very poor) to 5 (excellent), the average rating was an impressive 4.26 (Forer, 1949)!

As you can see from the profile Forer used (see Table 12.1), the statements were fairly general and most of them could apply to most people, at least some of the time. It is easy for people to see themselves in statements such as "While you have some personality weaknesses, you are generally able to compensate for them," and of course, just about everybody tends to be extraverted *sometimes* and introverted other times, or to have unrealistic goals. The Barnum effect may be a key reason why personality tests of questionable validity (as well as horoscopes, astrologers, psychics, and the like) are so widely believed.

Table 12.1 Bertram Forer's Personality Profile

Table 12.1 Bertram Forer's Personality Profile

Forer provided the following profile to all of the participants in his study, regardless of their answers on a personality test.
You have a great need for other people to like and admire you. You have a tendency to be critical of yourself. You have a great deal of unused capacity that you have not turned to your advantage. While you have some personality weaknesses, you are generally able to compensate for them. Your sexual adjustment has presented problems for you. Disciplined and self-controlled outside, you tend to be worried and insecure inside. At times you have serious doubts as to whether you have made the right decision or done the right thing. You prefer a certain amount of change and variety and become dissatisfied when hemmed in by restrictions and limitations. You pride yourself as an independent thinker and do not accept others' statements without satisfactory proof. You have found it unwise to be too frank in revealing yourself to others. At times you are extraverted, affable, sociable, while at other times you are introverted, wary, and reserved. Some of your aspirations tend to be pretty unrealistic. Security is one of your major goals in life.

Source: Forer, B. R. (1949). The fallacy of personal validation: A classroom demonstration of gullibility. *Journal of Abnormal and Social Psychology*, *44*, 118–123.

In contrast, rigorous empirical research over the past several decades has narrowed the many potential personality traits into a small number of factors. The statistical technique called **factor analysis** is *used to group items that people respond to similarly*; for instance, the terms *friendly*, *warm*, and *kind* have similar meanings, and can be grouped in a cluster, referred to as a *factor*. Once we identify the items that cluster together, we can name the factor to indicate that all of the traits are referring to more or less the same thing: friendly, warm, and kind may be viewed as three different ways of describing a factor we may call “friendliness.”

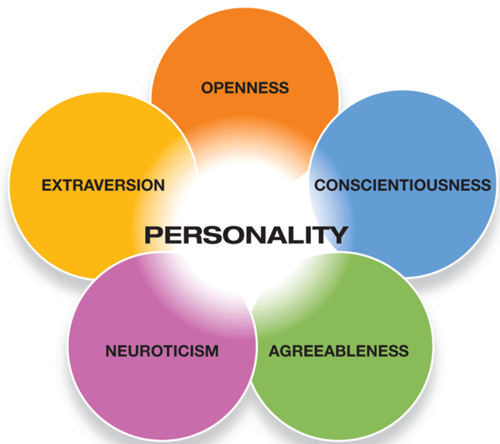
The Five Factor Model

Listen to the Audio

Using factor analysis, psychologist Raymond Cattell (1946) narrowed the list of key personality traits to 16, thereby simplifying and standardizing the number of dimensions psychologists needed to describe the composition of personality. Forty years later, McCrae and Costa (1987) created the **Five Factor Model (FFM)**, *a trait-based theory of personality based on the finding that personality can be described using five major dimensions*; this model has become the most popular trait-based approach for academic personality researchers, and has been cited in hundreds of research articles.

To understand the Big Five traits, consider what characteristics are associated with people high and low on that trait. These are the "kinds of people" described by each trait (see Figure 12.1).

Figure 12.1 The Big Five Personality Dimensions



Factor	Characteristics of High Scorers	Characteristics of Low Scorers
OPENNESS	Creative, artistic, curious, imaginative, nonconforming	Conventional, down-to-earth
CONSCIENTIOUSNESS	Ambitious, organized, reliable	Unreliable, lazy, casual, spontaneous
EXTRAVERSION	Social, enjoy high levels of stimulation	Reserved, enjoy low levels of stimulation
AGREEABLENESS	Good-natured, trusting, supportive	Rude, uncooperative, irritable, hostile, competitive
NEUROTICISM	Worried, insecure, anxiety-prone	Tranquil, secure, emotionally stable

A widely used measure of personality is the NEO Personality Inventory (NEO-PI-R). Individuals rate themselves on multiple questions that reflect the traits of openness, conscientiousness, extraversion, agreeableness, and neuroticism. (To help you remember the Big Five, note that the first letters of the traits spell out OCEAN.)

Source: Based on McCrae, R. R., & Costa, P. (1987). Validation of the Five-Factor Model of personality across instruments and observers. *Journal of Personality and Social Psychology*, *52*(1), 81–90.

Openness

Individuals high in openness (high Os) would likely show greater curiosity and creativity. As a result, they may hold beliefs that would be considered unconventional. In contrast, individuals low in openness (low Os) may defend the status quo and prefer the conventional.

Conscientiousness

Highly conscientious people (high Cs) tend to be organizers—efficient, self-disciplined, punctual, and dependable. High Cs are often great employees and students in fields such as engineering and accounting, where attention to detail is paramount. On the other hand, highly conscientious people may be more likely to experience negative stress on the job and are preoccupied with order and perfection (Bastiaansen et al., 2011; Cianci et al., 2010). Their counterparts with Low Cs tend to be less organized and detail oriented.

Extraversion

Extraverts (high Es) are the socializers and sensation seekers. Extraverts tend to be more assertive, talkative, and enthusiastic, preferring high levels of stimulation and excitement much of the time. Introverts (low Es) are the quiet ones. Although they may seek social contact, introverts also need alone time, especially if they've been overwhelmed by the high levels of stimulation at social functions.

Agreeableness

Highly agreeable people (high As) seek to have people get along well and keep conflicts to a minimum. To some extent, their agreeableness comes from valuing harmony with others and a willingness to put their own interests aside in order to please others. However, agreeableness may be more about avoiding the discomfort of arguments and disagreements than with pleasing others. As you might expect, they can make great roommates or coworkers by trying to please you. However, a lack of assertiveness can hold them back in some ways, such as slowing career advancement in a competitive workplace (Bozionelos et al., 2014). At the other end of the scale, Low As are the type who value being authentic more than maintaining agreeable harmony. Although it would be easy to interpret this as being argumentative and mean-spirited, being a Low A is

not the same as being *dis*agreeable. Some very polite scholars, attorneys, and even sports fans can have fierce debates and walk away unscathed—disagreeing is perfectly normal to a Low A.

Neuroticism

People high in neuroticism (high Ns) are often difficult to deal with. They may have strong reactions to negative events, or even neutral events that they manage to interpret negatively. They are prone to bad moods and can dwell on perceived flaws or injustices. Low Ns, on the other hand, tend to be secure and confident, and let go of negative emotions easily. Rather than blowing things out of proportion, the low Ns take the good with the bad, and deal with problems as they arise, but feel no need to create problems where there aren't any, or to obsessively look for problems until they find them. Low Ns tend to be successful at managing their emotions, and are regarded by others as "stable."

Ratings of "high" or "low" on any of the Big Five factors can easily be construed as "good" or "bad," such as being "high N" or "low E." However, this is not necessarily a lesson that should be taken from research on the Big Five, as the "optimal" level for healthy psychological functioning may be somewhere in the midpoint of these personality factors (Carter et al., 2018). Taken together, the Big Five factors are useful for understanding people's behaviours, thoughts, and emotions. Nevertheless, despite the usefulness of the Big Five, psychologists often find that there are other personality traits, outside of the Big Five, that are useful for understanding certain things, such as why people do things that many of us would consider evil.

Psych@

Work

For many jobs, successful completion of specific tasks is just one metric of an employee’s value to a company or organization. Employees also work within a system that relies on attributes such as leadership and cooperation, which are qualities that relate to personality traits. An employee could be stellar in their ability to remember all of the details of each and every electronic device on the sales floor, but if they refuse to work well with others on the sales team, the organization and its employees suffer. Industrial and organizational (I/O) psychologists (described in Module 1.2) specialize in maximizing productivity in the workplace by intelligent selection and training of employees, and by recommending incentives and working conditions that enhance productivity, as well as physical and mental health. I/O psychologists administer numerous tests and scales to assess whether job applicants are suited for a particular job, and how they may best fit within an organization. Of course, there are many kinds of jobs available. Being a team player (e.g., agreeable) might not be as important to a self-employed individual who spends their entire day writing code. However, for most jobs, ranging from construction work to health care, psychologists have found that high levels of conscientiousness, agreeableness, and emotional stability predict employee and organizational success (Sackett & Walmsley, 2014). It may sound like a cliché to say that the most important resource for a company is its workforce, but research and practice in IO psychology has provided scientific evidence to back it up.

Beyond the Big Five: The Personality of Evil?

Listen to the Audio

It is both tragic and baffling to contemplate truly destructive human behaviours: child abuse, wartime atrocities, the Holocaust, 9/11. The more horror we allow ourselves to contemplate, the more we must ask *why?* Why do people do such terrible things?

Following World War II, such questions were a major focus in personality psychology, as the world wanted to understand the rise of fascism and Hitler's ability to mobilize millions of people to carry out his plans of destruction. Early research by Theodore Adorno suggested that a key personality type, the *authoritarian personality*, was a big piece of the puzzle. Authoritarians were theorized to be rigid and dogmatic in their thinking, to separate their social world into strict categories of *Us* and *Them*, and then to believe strongly in the superiority of *Us* and the inferiority of *Them*. As a result, authoritarians were more likely to endorse and engage in prejudice and violence, particularly toward people in the *Them* category (Adorno et al., 1950). Although there is some overlap between this construct and other, related personality factors (e.g., openness to experience), over the past several decades, personality researchers have discovered important personality traits that extend the Five Factor Model and help to shed light on the problem of human "evil."

Honesty–Humility

Listen to the Audio

Researchers at Brock University have developed the **HEXACO model of personality**, *a six-factor theory that generally replicates the five factors of the FFM and adds one additional factor: Honesty–Humility*. Individuals scoring highly on this factor (high HHs) tend to be sincere, honest, and modest, whereas those with low scores (low HHs) are deceitful, greedy, and pompous (Ashton & Lee, 2007). Whereas high HHs are more likely to perform altruistic, pro-social behaviours, low HHs have more selfish, anti-social, and violent tendencies (Ashton & Lee, 2008; de Vries & van Kampen, 2010), being more likely to "do whatever it takes" to get what they want, to manipulate others, and to break the rules (Bourdage et al., 2007). Interestingly, low HHs feel a strong sense of self-importance and a feeling of entitlement, like they deserve to have their desires fulfilled. Thus, the HEXACO model seems to describe "evil" as placing an excessive importance on the self, and none placed on the other (except in terms of how the other can be used to further the goals of the self).

The Dark Triad

Listen to the Audio

A different set of research studies conducted at the University of British Columbia has uncovered three traits that are believed to be central to understanding the personality roots of evil. This **Dark Triad**—*Machiavellianism, psychopathy, and narcissism—describe a person who is socially destructive, aggressive, dishonest, and likely to commit harm in general* (Paulhus & Williams, 2002). Taken together, these traits also describe a person who gives excessive importance to the self, and little to no importance to others.

Machiavellianism is a tendency to use people and to be manipulative and deceitful, lacking respect for others and focusing predominantly on their own self-interest. Relationships are approached strategically, using other people for how they might be able to provide some sort of benefit to the self.

Psychopathy is a general tendency toward having shallow emotional responses. Individuals scoring high in psychopathy veer toward highly stimulating activities and tend to feel little empathy for others. They often get a thrill out of conflict, exerting control, or even harming others, and feel little remorse for their actions.

Narcissism reflects an egotistical preoccupation with self-image and an excessive sense of self-importance. The extreme narcissist is "full of himself" (or herself). In Greek legend, the hunter Narcissus was filled

with excessive pride and adoration toward himself. This was his fatal flaw, however, as he was so transfixed by his own gaze reflecting in a pool of water that he died by the poolside, still staring at his reflection. Narcissists can often be charming, but are difficult to have as relationship partners because they tend to always put themselves first rather than considering their partner's needs.

Considering these traits separately yields some important insights; for example, people high on different traits may become aggressive for different reasons (Jones & Paulhus, 2010). But their real power comes when you consider them all together. The convergence of these three factors, the Dark Triad, strongly predicts anti-social tendencies. People who score highly on all three of the Dark Triad traits are substantially more likely to commit harm to others, having little empathy or other constraints to prevent them from doing so. Finally, as compelling as the Dark Triad appears to be, it should be noted that personality psychologists are not unanimous in their belief that the three traits that comprise it are truly distinct from existing models of personality, such as HEXACO or the Big Five (Muris et al., 2017). Others suggest that the Dark Triad should be amended to include sadistic personality (Mededović & Petrovic, 2015), which can be found in people lurking in our everyday encounters.

#Psych

Internet Trolls

Not everyone behaves the same online as they do in person. Internet trolls, the primary perpetuators of uncivil online behaviour, seem to thrive on the discomfort and misery they impose upon others. They seem to permanently lurk in the

comment sections of news, political, social media, and just about any other type of website that allows people to exchange thoughts, information, and opinions (probably the ultimate bait for trolls). So what is the personality of a troll? You might think you could answer this question with intuition, but there is much about personality psychology that can only be understood through scientific study. Dr Erin Buckels, a Canadian researcher, has become an expert on the study of internet trolling, and the underlying personality characteristics of these perpetrators. In one study, Buckels and her colleagues (2018) queried research participants about their internet trolling habits (you can take a version of the questionnaire at the end of this module) and then tested them on their tendencies toward sadistic behaviour. Someone behaving sadistically derives pleasure from the suffering of others, particularly innocent individuals. Participants viewed pictures of people under emotional and physical duress and rated the level of pain the subjects were experiencing. The participants were also asked whether they experienced pleasure in viewing the photos. Buckels and colleagues found that participants who were the most likely to troll on the internet were also more likely to demonstrate sadistic personality tendencies, including minimizing the pain experienced by other people and deriving pleasure from viewing it. The anonymous cover provided by the internet removes a layer of inhibition that *might* hold everyday sadistic behaviour in check.

Right-Wing Authoritarianism

Listen to the Audio

In another line of research into the causes of evil behaviour, Bob Altemeyer at the University of Manitoba has identified **Right-Wing Authoritarianism (RWA)** *as a problematic set of personality characteristics that also predisposes people to certain types of violent or anti-social tendencies. RWA involves three key tendencies*:

1. obeying orders and deferring to the established authorities in a society;
2. supporting aggression against those who dissent or differ from the established social order; and
3. believing strongly in maintaining the existing social order. (Altemeyer, 1996)

At the centre of the RWA personality is a strong tendency to think in dogmatic terms, where, metaphorically speaking, everything is either black or white, with no shades of grey. RWAs tend to hold strong beliefs and are highly resistant to changing them (Altemeyer, 1996). They are generally more prejudiced, tending to negatively judge people who hold different perspectives from them (see Module 13.2). As a result, RWAs are likely to advocate a harsh stance toward people who deviate from the established social order, such as political activists, feminists, atheists, and members of ethnic minorities (Goodman & Moradi, 2008; Haddock et al., 1993; Narby et al., 1993). Given their unquestioning acceptance of authority figures, high RWAs are more likely to agree with unethical

decisions made by leaders (Son Hing et al., 2007) and to have positive attitudes toward corrupt governments (Altemeyer, 1996).

As a result of these tendencies, high RWA individuals were likely instrumental in the rise of fascism that led to World War II, and will likely play important roles in the repressive dictatorships, destructive business practices, and unhealthy family structures of the future. Right-Wing Authoritarianism is currently on the rise at a global scale, not just within portions of North America (Norris & Inglehart, 2019).

The theory of Right-Wing Authoritarianism also shares with the previous two theories an emphasis on people placing excessive emphasis on their own self-importance. In the case of RWA, this tendency manifests as excessive certainty and unwavering conviction in their personal opinions, coupled with strong in-group favouritism and beliefs that are prejudiced and derogatory toward members of other "out-groups."

Working the Scientific Literacy Model

Right-Wing Authoritarianism at the Group Level

Listen to the Audio

What do we know about RWA?

As we just discussed, personality researchers have identified RWA as a cluster of characteristics that make society a less warm and friendly place, being related to generally harmful tendencies such as holding prejudiced views against other groups and an excessive and closed-minded allegiance to societal conventions. It's relatively easy to imagine how people who are high in RWA might end up behaving in social situations. But it's another thing entirely to consider what could happen in situations involving lots of people high in RWA. When a group of closed-minded, prejudiced, violence-prone individuals get together, what could possibly go wrong?

How can science determine how RWA affects groups?

In one fascinating and highly disturbing study, Altemeyer (1996) selected high- and low-RWA participants to play a complex role-playing simulation of Earth's future, called the Global Change Game. This game is generally played by 50 to 70 people who are organized into groups that represent different regions of the world; these groups then make decisions about how their region behaves on the international stage. For example, participants

decide how their region will deal with problems such as environmental degradation, poverty, overpopulation, and military threats. The simulated conditions of Earth change depending on the actions of the players, thus providing a fairly realistic simulation of the challenges of governance in the international community.

In order to test how RWAs play the game, Altemeyer ran through the game twice, once with 67 individuals who scored very low on the RWA scale, and once with 68 people who scored very high. Each simulation covered 40 years of time into Earth's future. The results were, frankly, astonishing.

In the low-RWA group, there were no wars or military build-up over the 40-year time period. Instead, regions steadily downsized their militaries and diverted the money into humanitarian and environmental projects. They also collectively resolved challenges through international meetings and cooperation. At one point, a global crisis occurred due to a threat to the Earth's ozone layer. Players responded by holding a group meeting, and agreeing to make large investments in technology development so that they could collectively solve the problem. By the end of the game, food, health services, and jobs were provided for almost all people on Earth, resulting in a peaceful, stable world.

In the high-RWA group, players tended to interpret the actions of others as aggressive and responded in kind. Militaries quickly grew and war ensued, leading to a global nuclear war that wiped out every human being on the planet. At this point, the players were given a second chance to play, starting at a point prior to the nuclear war. Despite having the chance to learn from their earlier mistakes, the players nevertheless were incapable of getting along with each other. When the ozone crisis occurred,

no international summit was called and only one region took action to avert the crisis. Instead of cooperation, players remained suspicious of each other and rapidly developed their militaries. One major military conflict killed 400 million people, and players poured so much money into military expenses that devastating social and environmental problems were never dealt with. At the end of the 40-year period, the world was again divided into armed camps on the brink of all-out war.

At the very least, this simulation suggests that we have to consider not only how factors like RWA operate in isolation, but how they operate in interaction with other people in real situations. Studying how personality characteristics operate on more collective scales is a major new frontier for the personality field that needs further exploration. It also suggests that we need to think carefully, as a society, about the personality characteristics of the people we allow into positions of power. These simulations suggest quite strongly that if several highly authoritarian leaders ended up in some sort of conflict, they may be highly prone to escalating conflicts to acts of extreme violence.

Can we critically evaluate this research?

There are several methodological limitations to this study that should be taken into consideration when evaluating the findings. First, there are external validity concerns; for example, playing a game with no real consequences does not necessarily indicate how people would respond in a real-life situation. It is possible that in a real situation, people would be more sensitive to the consequences of their actions and would not be so willing to risk human lives. Furthermore, the simulations were only performed on one night with each group; therefore, results could have been due to chance factors, such as particular individuals having a strong impact on the outcomes. Also, because only university

students participated in the study, the results may not generalize to the rest of the population. Obviously, this was not a highly controlled set of studies, and the findings must therefore be interpreted very cautiously. However, as a case study of this particular type of competitive circumstance involving high- and low-RWAs, the results remain quite alarming and suggestive.

Why is this relevant?

This research illustrates the highly destructive impact that authoritarian personalities may have in group settings, and it sounds a clear warning bell in the 21st century. We are living in a time in which our world faces unprecedented challenges that require international cooperation, yet intolerance and intergroup hostilities are rampant and ideological fundamentalism and fanaticism heavily influence politics in many countries. Greater understanding of the potential roots of intergroup hostility in individuals′ personalities is urgently needed at this time.

Personality Traits over the Lifespan

Listen to the Audio

Have you ever looked back on something you wrote several years ago, perhaps in a diary or journal, and wondered, “Who was that person who wrote these things?” Or maybe you have looked back at someone you once dated and wondered, “Who was I when I chose to date that person? It certainly wasn’t ‘me’!” One of the most fascinating issues in personality psychology is whether we stay basically the same, or whether our fundamental personalities change as we age.

Temperaments

Listen to the Audio

A mountain of research from different areas within psychology has revealed considerable stability in our personalities. In fact, given the large genetic contribution to personality factors, our personalities start developing even before we are born, so could be expected to remain largely stable over time (Plomin & Caspi, 1999; Yamagata et al., 2006).

In child development studies, researchers have found that infants possess different *temperaments* right from birth, which also supports the view that the seeds of our personalities are present right from the start. Infants display their temperamental differences along dimensions such as activity level, mood, attention span, and distractibility (Rothbart & Bates, 2006; Thomas & Chess, 1977). As most parents with multiple children can attest, children come "hard-wired" to be a certain way. Some infants are generally active and happy, whereas others are more tranquil, and still others are easily upset. So, if you're a parent pulling your hair out with your chronically distressed child who seems impossible to deal with, don't judge yourself too harshly. Remind yourself that infants have different temperaments and your power as a parent is small compared to the power of their genes.

Thus, temperament seems to represent an innate, biological foundation upon which personality is built. This foundation, combined with the genetic research, suggests that personality traits should be stable over time. To some extent, research confirms that this is the case: Infant

temperament predicts the adult personality traits of neuroticism, extraversion, and conscientiousness (Evans & Rothbart, 2007).

One amazing study that followed the same children from age three until adulthood showed that temperament at three years of age was strongly predictive of behavioural tendencies, personality, and life outcomes many years later (Caspi, 2000). Three main temperaments were identified:

- Well-adjusted. Capable of self-control, confident, not overly upset by new people or situations
- Under-controlled. Impulsive, restless, distractible, emotionally volatile.
- Inhibited. Socially uncomfortable, fearful, easily upset by strangers.

Just over 10 years later, children of different temperaments had developed quite different behaviour patterns. The *under-controlled* children (relative to the other groups) had become the most likely to engage in *externalizing behaviours* (fighting, lying, disobeying), whereas the *inhibited* children developed mainly *internalizing* behaviour patterns (e.g., worrying, crying easily). By age 18, their emerging adult personalities were reflections of their temperaments at age three.

Is Personality Stable over Time?

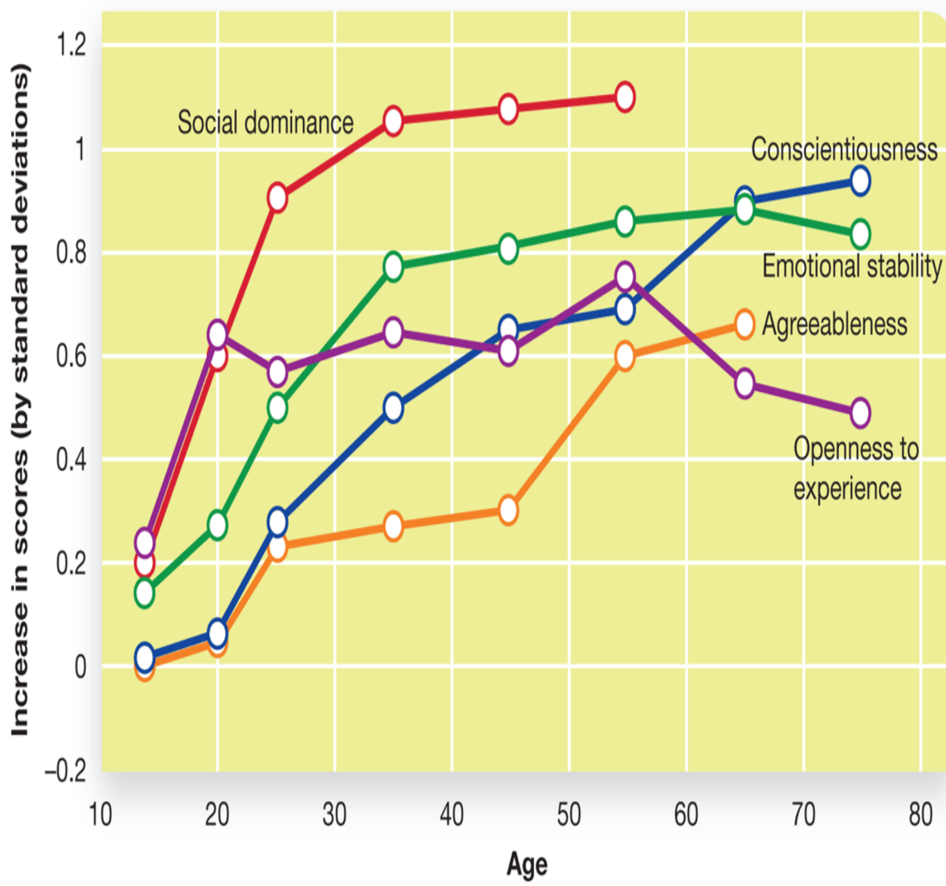
Listen to the Audio

There are a number of factors—both behavioural and biological—that make personality stable over time. Personality processes tend to become self-perpetuating; personality traits that lead to behaviours that receive positive reinforcement are more likely to become stable characteristics of that individual (Heatherton & Weinberger, 1994). As an example, take the personality factor of conscientiousness. As we discussed earlier, highly conscientious people will tend to be organized, punctual, and dependable; they are therefore more likely to succeed, be respected by others, and create professional opportunities for themselves. Their successes then feed back to reinforce personality type.

However, research has also shown that personality *can* change, particularly in late adolescence and early adulthood. For example, young adults tend to experience fewer negative emotions than do adolescents, reflecting decreases in neuroticism. Also, conscientiousness, agreeableness, and social dominance (an aspect of extraversion) all increase in early adulthood (Roberts et al., 2006; see Figure 12.2). Take a moment and consider why personalities change in these systematic ways over time. One likely explanation is that, over time, our environments change and so do the roles we play in those environments. For example, adults have to be more conscientious than children because they have so many more responsibilities—like taking care of their unconscientious children! In contrast to conscientiousness, openness tends to decline in middle and old age, especially among adults who tend

to avoid engaging in new cultural activities (Schwaba, et al., 2018). Over time there are many such changes—in our environments, our social roles, the amount of choice and power we have, the sophistication of our thinking processes, the development of our bodies and brains, and many other things—so there may be many reasons why personalities change over time.

Figure 12.2 Personality Stability and Change over the Lifespan



Average scores of Big Five traits change over the lifespan. Generally, most traits become more positive through adulthood, although there are anomalies. Social dominance (an aspect of extraversion) remains stable after age 40. Conscientiousness does not begin rising until after the traditional college years. Openness to experience only rises up to the traditional college years, then remains largely stable until old age, when it declines (Roberts et al., 2006).

Source: Based on Roberts, B., Walton, K., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life-course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*(1), 1–25.

Nevertheless, even these data describe a kind of personality stability, in that although people's personality traits may fluctuate over time, their rank ordering in the population remains very stable. That is, a 25-year-old who is more extraverted than other twentysomethings is likely to someday be a 65-year-old who is more extraverted than other people in their 60s. This approximate ranking seems to remain in place over time, even though the overall level of extraversion may change over that time period (McCrae & Costa, 1990).

Personality Traits and States

Listen to the Audio

Trait labels may go a long way toward describing what people are like. However, many psychologists are quick to point out that no matter how useful traits may seem, people's behaviour is also determined by situational factors and context. You may know someone whom you would describe as very calm and tranquil, yet one day he curses and screams at other drivers on the road. In contrast to a personality trait, a **state** *is a temporary physical or psychological engagement that influences behaviour*. Perhaps your normally calm friend lashed out at other drivers on the road because he was criticized earlier that day or made a mistake that made him feel foolish, and so he was defensively displacing his bad feelings onto other people. Even people who seem highly consistent in how they express their neuroticism, agreeableness, or extraversion will not behave in the same way across all situations, and this observation has led to some strong criticisms of trait theories of personality (Mischel, 1968; Mischel & Shoda, 1998). However, we generally understand now that states and traits work together; traits describe a person's general personality tendencies, whereas states describe what that person is like in specific sets of circumstances.

The specific ways in which states and situational factors interact to influence us is a challenging topic that research has only begun to scratch the surface of. Try to think of the number of different situations or states you find yourself in across any average day. For example, you can be awake, asleep, or half-asleep; happy; sad; excited; skeptical;

embarrassed; confident; or unsure of yourself. You could be having a crisis or you could be completely relaxed. The list could go on forever—and as you might have guessed, psychologists have tried to see just how long it gets. In one study, 77 college students were asked to describe as many situations as they could that they might encounter. Their total reached more than 7000. Perhaps you can now see why many psychologists would rather focus on five personality dimensions. Fortunately, Saucier and colleagues (2007) took these 7000 situations and reduced them to four general aspects of situations that are most likely to influence our behaviour:

1. Locations (e.g., being at work, school, or home)
2. Associations (e.g., being with friends, alone, or with family)
3. Activities (e.g., awake, rushed, studying)
4. Subjective states (e.g., mad, sick, drunk, happy)

These situations influence how and when our personality traits are expressed. Identifying these situations is important because they interact with personality traits to determine our behaviour. If you think that other situational factors could be added to this list you are not alone. For example, you might behave differently if a situation you were in had important, personal consequences, rather than being trivial. Or situations can bring about adversity, and how you respond might depend more on the circumstance rather than a stable personality trait. Because personality psychologists grapple with such an extraordinarily complex aspect of human behaviour, they naturally have different ways of conceptualizing situations (Rauthman et al., 2015).

Behaviourist and Social-Cognitive Perspectives

Listen to the Audio

You probably didn't have much trouble understanding the trait perspective to personality. Indeed, using traits to describe people is something we do regularly, particularly in Western cultures. However, the trait approach does tend to reinforce certain assumptions that other psychologists have called into question. Most importantly, the trait approach reinforces the assumption that we carry our personality characteristics around inside us. We treat traits like they are "things" that we "have," which then influence our thoughts, feelings, and behaviours. This approach does not examine how personalities are influenced by our experiences.

The Behaviourist Perspective

Listen to the Audio

The behaviourist would note any identifiable patterns of behaviour and seek to understand how that behaviour was elicited by specific environmental conditions. Notable psychologist B. F. Skinner, for example, believed that "personality" is simply a description of the response tendencies that occur in different situations. For example, when with a group of people, your behavioural responses to that situation might include dominating the conversation, asking a lot of questions, laughing along at other people's jokes, or generally remaining silent. Presumably, the behaviours you engage in are based on your past experiences. If you tend to dominate the conversation and laugh at people's jokes, then you were likely reinforced for those behaviours in the past. A behaviourist might note that using the personality dimension of "extraversion" is an unnecessary addition—it is just a label that does not help us understand the simple relationship between stimulus and response (see Figure 12.3).

The Social-Cognitive Perspective

Listen to the Audio

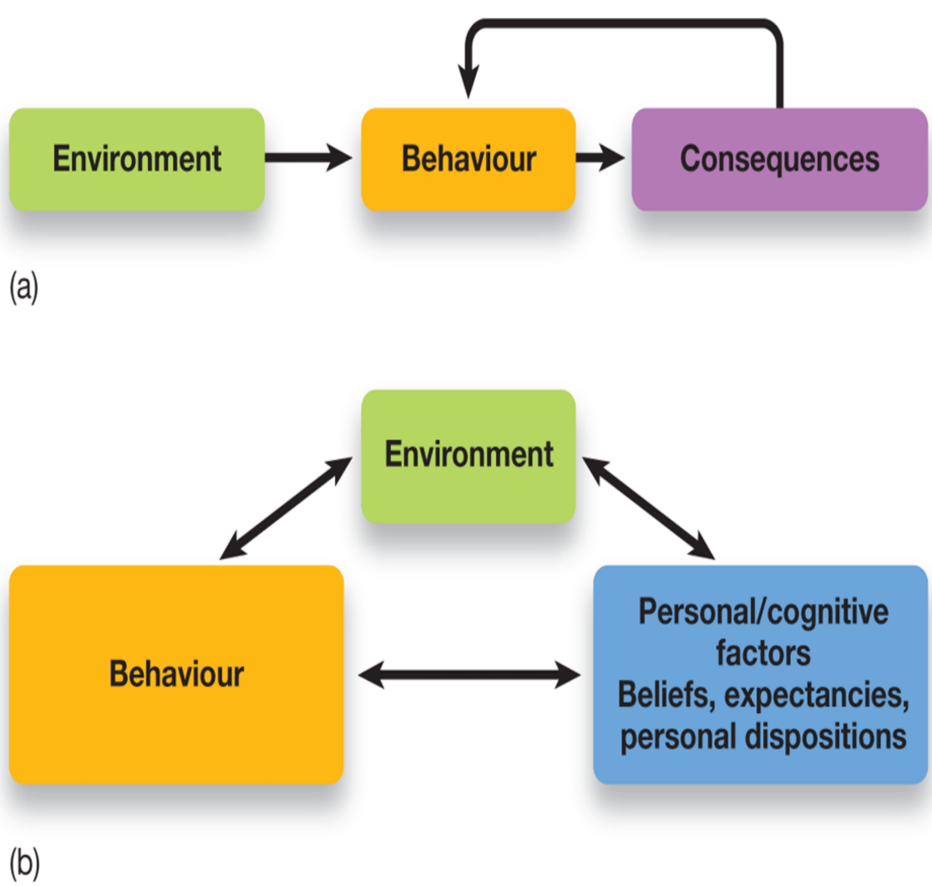
In the mid-20th century, behaviourism had to make room for the emerging social-cognitive perspective; this shift had a major impact on our understanding of personality. Specifically, the social-cognitive theorists, like Albert Bandura, placed central importance on the role of cognition and the person's inner subjective interpretation of their circumstances. No longer was the individual simply an object, affected by environmental circumstances. Now the person became an agent, actively constructing meaning out of their circumstances, and then making choices to behave in ways that affect those circumstances. From a social-cognitive perspective, what became clear was the *relationship* between the person and the environment, plus how this relationship is bound up with the person's thoughts and interpretations.

According to Bandura's social-cognitive theory, personality develops out of the person's interaction with the environment; this differs from behaviourism in that the person ends up forming *beliefs* about their relationship to the environment, especially beliefs about their own actions and the likely consequences that will follow from their choices. For example, Bandura was keenly interested in the concept of *self-efficacy*, the belief that a person's attempts to accomplish a specific task will be successful. People with a higher degree of self-efficacy are far more likely to take action, especially difficult actions where the rewards are not immediately obvious, whereas people with little self-efficacy for a task will be unlikely to try, and will give up more easily. Thus, Bandura

emphasized how beliefs, such as self-efficacy beliefs, form out of our interactions with the environment. These beliefs then become their own causal force, exerting influence over our behaviours and how we interact with the environment.

If you put all this together, you can see how Bandura (1978) saw personality as a kind of integrated web of many different processes. His central idea was called **reciprocal determinism**, based on the idea that personality emerges from the *interactions between behaviour, internal (personal) factors, and external (situational) factors, all of which mutually influence each other* (see Figure 12.3). The ultimate goal of a social-cognitive perspective is to achieve a fully holistic understanding of the person as a system of interdependent processes.

Figure 12.3 Behavioural and Social-Cognitive Approaches to Personality



(a) **Behaviourist Account of Personality**. Behaviourists thought that what psychologists call personality was an expression of relationships between behaviour, rewards, and punishment. Behaviourists avoided referring to personality traits and dispositions, instead focusing on how past experiences predict future behaviours. For example, whether someone tends to be pessimistic might be based on past experiences of feeling a lost sense of control. **(b) Reciprocal Determinism and the Social-Cognitive Approach**. According to Albert Bandura and colleagues, personality is a product of dynamic interactions between behaviour and reinforcement, and, importantly, the beliefs, expectancies, and dispositions of the individual.

Researchers like Bandura appreciated the added insight that was encouraged by taking a social-cognitive approach to understanding people. Focusing on thoughts and beliefs opened up whole layers of beliefs, interpretations, expectations, and biases for consideration. For example, examining a person's beliefs may reveal that they think they are worthless, that other people generally won't like them, that they tend to mess things up, or have other self-defeating convictions. These beliefs may be the most important force keeping their "personality" (i.e., their pattern of interaction with the environment) from changing. The hope, therefore, is that by learning to change some aspects of the social-cognitive system, such as self-defeating beliefs, the whole system can change.

For example, imagine a person who is highly neurotic (from a trait perspective). Knowing this may make the person want to improve and become less neurotic and unpleasant to be around. But this doesn't really give much guidance as to how to actually DO this. What is one supposed to change, in order to "be a different person?"

A social-cognitive theorist like Bandura would take a look at the processes through which the person seemed to express and reinforce their neuroticism. Perhaps the person holds certain expectations, like fear-based beliefs that things will generally turn out poorly, or that other people can't be trusted to do the right thing. As a result, the person feels a lot of anxiety and tries to deal with this by controlling things around them, thus developing a pattern of being controlling, critical, and unwilling to trust or rely on others. As you start to "unpack" this whole system of self-reinforcing beliefs and behaviours, you find the specific factors that could help that person change. For example, perhaps this specific person could examine the beliefs they hold about trusting other people and identify how these are connected to other beliefs (e.g., "I will do a better job if I do it myself"), which in turn are connected to other beliefs (e.g., "If I mess things up, people will be angry with me"). Through this kind of "analysis" of related beliefs, the person uncovers specific leverage points—processes that they can change that will then change their belief system.

Module 12.1 Summary

Listen to the Audio

12.1a Know . . . the key terminology associated with contemporary approaches to personality.

Review Module 12.1

Start Over Swap

0/11 REVIEWED · 0 MASTERED

right-wing authoritarianism (RWA)

Previous Next Got It!

12.1b Understand . . . the behaviourist and social-cognitive views of personality.

A strict behavioural account of personality identifies the stimuli that control a person's responses. From a behaviourist perspective, there is

little need for trait terminology, such as neuroticism or conscientiousness, and no reference to cognitive factors such as beliefs or thoughts. The social-cognitive approach to personality instead emphasizes that situations, behaviours, and thoughts reciprocally determine each other.

12.1c Apply . . . self-report methods to understand your own personality.

Personality psychologists usually describe individuals based on their scores on scales devised to measure either general traits (e.g., the Big Five), or they develop scales for more specific questions about personality.

Apply Activity

Is being an "internet troll" related to other measures of personality? Canadian researcher Dr. Erin Buckels and colleagues (2018) developed an attitude toward online trolling questionnaire to quantify a person's trolling tendencies as a part of the researchers' larger work relating online behaviour to personality traits. Below is a modified version of their scale you can complete if you are interested in seeing your trolling tendencies.

Below are some questions about your attitudes toward online trolling. Please rate your agreement with each statement using the rating scale provided above the questions.

Strongly disagree	Disagree	Unsure	Agree	Strongly agree
1	2	3	4	5

1. I consider myself to be a troll.
2. I enjoy watching other people get trolled.
3. Trolling behaviour does not make me angry.
4. Trolls share my perspective on life.
5. Trolling behaviour is not cruel and is necessary.
6. My online personality is typical of a troll.
7. I enjoy trolling other people.
8. I like trolls.
9. Trolling behaviour should not be punished.
10. I share political views with online trolls.
11. We do not need safeguards to prevent online trolling.
12. I identify with trolling culture.

How internet trolling relates to other aspects of personality dimensions was discussed in the #Psych feature on Internet Trolls. In case you are interested, the average score from the sample of 345 adults in Buckels et al. (2018) was 1.61.

12.1d Analyze . . . the personality roots of violence and prejudice.

Canadian researchers have identified three sets of factors that predict violence and prejudice that are not fully captured by the Five Factor Model. The first is the Honesty–Humility dimension of the HEXACO model of personality. The second is the Dark Triad of psychopathy, Machiavellianism, and narcissism. The third is Right-Wing Authoritarianism. Research has found that these traits predict many dysfunctional patterns of thoughts, emotions, and behaviours. Understanding the causal underpinnings of these traits and developing strategies to help individuals with such personality traits would be a key advance in promoting a healthier and more peaceful society.

12.1e Analyze . . . the relative roles of personality traits and psychological and physical states in determining behaviour.

The debate over whether personality traits influence behaviour or whether situational factors play a bigger role in behaviour is ongoing in the field of personality psychology. In reality, both sets of factors are important. Personality traits can be remarkably consistent, yet the situations we find ourselves in can lead to unexpected behaviour.

Module 12.2 Cultural and Biological Approaches to Personality

Listen to the Audio

Christopher Futcher/E+/Getty Images

Learning Objectives

12.2a Know . . . the key terminology associated with cultural and biological approaches to personality.

12.2b Understand . . . how evolutionary theories explain personality.

12.2c Apply . . . your knowledge to arrive at accurate conclusions about the influences of biological and cultural factors on personality.

12.2d Analyze . . . claims that males and females have fundamentally different personalities.

12.2e Analyze . . . the genetic basis of personality.

Apparently, if you're travelling abroad, it is a good idea to sew a Canadian flag onto your backpack. The reason is that people in most parts of the world believe that Canadians are generally nice, polite, and friendly. So wearing the maple leaf should elicit positive responses from other people.

Are these beliefs about Canadians true? Obviously, there are all sorts of different people living in a country. Nevertheless, there does often seem to be a kind of "national character," doesn't there? Just try this—imagine the prototypical Swedish person. Now notice what came to your mind. The manic Swedish chef? Icy blond supermodels drinking vodka in a snowbank and looking at you with cool disdain? Now imagine a British person. Japanese? Australian? Iraqi? Jamaican? Did you find that specific types of people popped into your head for each example? Whether we endorse specific stereotypes or not, we certainly have absorbed basic sets of beliefs about people from various cultures, and

they tend to come to our minds. But are these ideas accurate? Is there such a thing as "national character" that applies to entire populations?

These questions are extremely interesting but unfortunately, we don't yet have all the answers. Many personality psychologists study cultural differences and similarities in personality and are working to understand how broad cultural forces interact with other factors to give rise to our personalities. In this module, we will explore the convergence of cross-cultural, evolutionary, and biological perspectives. By the end, we will have a better understanding of how these factors interact.

Culture and Personality

Listen to the Audio

Would you say Americans are WEIRD? It's okay, don't feel uncomfortable; this is a bit of a trick question. In this particular case, "WEIRD" stands for "Western, Educated, Industrialized, Rich, and Democratic." So yes, it would be fair to say that, on average, people from several cultures are WEIRD—Canadians, Western Europeans, Australians, New Zealanders, and definitely Americans (Henrich et al., 2010).

So, why does this matter? Consider this: Do you think there are any major differences between people who are WEIRD and people who are not? Of course there are. An "average" Torontonian likely would have very little in common with an "average" rural Mongolian farmer, for example.

Now consider that *almost everything you know* about psychology is based on studying people from WEIRD cultures. One study conducted at the University of British Columbia showed that 96% of psychology studies are conducted on a mere 12% of the population—the WEIRD ones (Henrich et al., 2010). This means our whole "scientific" understanding of the human animal is based on studying one specific, small, subgroup. Doesn't that seem a little . . . weird?

At the very least, this reminds us to be cautious in applying findings from psychology studies to the human species at large. It also means that we need to better understand the similarities and differences between people

in a variety of cultures. For example, one starting place would be to examine whether there are any important personality differences between the WEIRD and everyone else.

Universals and Differences across Cultures: The Big Five

Listen to the Audio

The Five Factor Model of personality centres around five personality dimensions: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. However, because these factors were discovered by researchers working in WEIRD places—the United States, Canada, and Europe—it is possible that the Five Factor Model only accounts for personality in WEIRD populations and may not apply to the rest of the world.

To find out whether the Big Five traits are truly universal, an enormous team of psychologists (there were 127 authors on this single article) measured the Big Five dimensions in more than 17 000 people speaking 28 languages and inhabiting 56 countries on six continents (they did not visit Antarctica). The Big Five factors were reliably found in all cultures that were studied. Despite the many differences that may exist between cultures, the people in those cultures do appear to share the same basic personality structures (McCrae et al., 2005; Schmitt et al., 2007). This finding is incredible, and suggests that the basic systems in the human personality are, in a sense, deeper than culture. Although individual personalities differ enormously, the basic machinery of the human personality system seems universal.

Personality Structures in Different Cultures

Listen to the Audio

The study just described is groundbreaking in its global scope, but a key methodological challenge remains. Because the Five Factor Model was originally created by performing a factor analysis of the personality adjectives in the English language, the kinds of questions that are asked on Big Five questionnaires are designed to measure the Big Five factors, and no others. Thus, when the scale is given to people from other cultures, the scale itself brings the biases of Western culture and the English language right along with it. What if other languages used different types of adjectives to describe personality? What if other cultures had different personality traits than the ones that emerge in the West? Re-analyzing personality from different linguistic starting points might reveal new personality factors that lie outside of the Big Five.

Researchers have begun to address this limitation, analyzing personality structure using personality descriptors in other languages; this work has already revealed unique personality factors not captured in the Big Five (Heine & Buchtel, 2009). For example, Cheung and colleagues (1996) examined indigenous Chinese personality traits, looking for patterns among the personality descriptors used in Chinese, rather than English. They found 26 new personality traits in total, and when they performed a factor analysis on all the traits including these 26 new ones, they found a different structure from the Big Five.

Instead of five traits, these researchers found four: dependability, social potency, individualism, and interpersonal relatedness. The first three traits were very similar to three of the Big Five traits (neuroticism, extraversion, and agreeableness, respectively), but the fourth, interpersonal relatedness, was unique. Interpersonal relatedness is a combination of characteristics concerning social harmony, tradition, and an emphasis on a person's social relationships. This finding may reflect a distinct personality dimension in the Chinese psyche, emphasizing the more socially interdependent nature of the self in this culture.

Other researchers have added to our multicultural understanding of personality, analyzing the personality traits found in Filipino, Spanish, and Greek languages, and seeking a more integrated cross-cultural theory of personality (Benet-Martinez & John, 1998; Church, 2001; Saucier et al., 2005). Each analysis has revealed new factors that seem to be independent of the Big Five.

Cross-cultural work on personality is still in its infancy, and clearly, many questions remain. At this point, most psychologists would agree that the Five Factor Model captures important and perhaps universal dimensions of personality, but also might miss important cultural-specific qualities that can only be understood by analyzing personality from that culture's own perspective (Church, 2010).

Comparing Personality Traits between Nations

Listen to the Audio

Despite the difficulties noted above, one important advantage of personality scales that have been translated into different languages is that psychologists can test for personality differences across cultures. Many such differences have been found. For example, consider the countries in Table 12.2 with the highest and lowest averages on each of the Big Five traits (Schmitt et al., 2007). (Interestingly, Canada falls roughly in the middle in each case.)

Table 12.2 Cultural Differences in the Big Five Personality Traits

Table 12.2 Cultural Differences in the Big Five Personality Traits

	Highest	Lowest
Extraversion	Serbia, Croatia	Bangladesh, France
Openness	Chile, Belgium	Hong Kong, Japan
Agreeableness	Jordan, Democratic Republic of the Congo	Japan, Lithuania
Conscientiousness	Ethiopia, Democratic Republic of the Congo	Japan, South Korea
Neuroticism	Japan, Argentina	Democratic Republic of the Congo, Slovenia

Source: Based on data from Schmitt, D. P., Allik, J., McCrae, R. R., Benet-Martinez, V., et al. (2007). The geographic distribution of Big Five personality traits: Patterns and profiles of human self-descriptions across 56 nations. *Journal of Cross-Cultural Psychology*, *38*, 173–212.

What do these differences really mean? Do they reflect actual personality differences between the people in those countries? Or could other things account for the findings? Many of the personality differences do seem puzzling. For example, why are Argentinians so neurotic, compared to people from the Democratic Republic of the Congo? Why are the Japanese so much less conscientious than Ethiopians? In fact, many of the findings in these large-scale cross-cultural studies defy cultural stereotypes (Terracciano et al., 2005), and it is a huge challenge for researchers to understand whether or not these differences are real.

One striking cultural difference that researchers have struggled to understand is also illustrated in Table 12.2. Isn't it interesting that a single country, Japan, ranked lowest of all countries on three out of the five traits (openness, agreeableness, and conscientiousness)? Given the general desirability of these traits, that is a fairly critical evaluation of the

Japanese personality! (The fact that they are among the most neurotic countries makes it seem even worse.) In fact, people from the entire South Asian part of the world rated their own personalities relatively negatively. Are these differences real? Is such a vast swath of humanity really so different from the rest of the world? It turns out that there may be a different explanation for at least some of the cultural differences found in personality studies. It is possible that people from different cultures have different **response styles**—*characteristic ways of responding to questions*; these response styles can be strongly influenced by cultural norms. For example, in one culture it may be more socially acceptable to say highly positive things about yourself, whereas in another culture the same behaviour may be considered rude or boastful. Indeed, researchers at the University of British Columbia have shown that there are such norms in South Asian cultures, discouraging people from emphasizing their strengths and successes, and instead encouraging people to be modest, humble, even self-critical (Heine, 2003; Markus & Kitayama, 1991; Mezulis et al., 2004).

An important critique of cross-cultural research is that it may lead to an emphasis on how cultures differ from each other, and obscure the fact that there is so much individual diversity *within* a culture that the average differences *between* cultures may not be that important after all. Therefore, it is important not to over-emphasize small average differences between groups and unduly reinforce group-based stereotypes.

Consistent with this point, the authors of the huge study discussed earlier finally concluded that the differences found in average trait ratings in different cultures are not sufficiently strong to justify beliefs in national character. "No convincing evidence has demonstrated that beliefs about national character" have any basis in fact, "despite their wide adoption and resistance to change" (Schmitt et al., 2007). Thus, the very researchers who are looking for cross-cultural differences in personality

ended up concluding that these differences are so small that it is misleading to think that people in different cultures are “different types of people.”

Comparing Personality Traits within Nations

Listen to the Audio

Another way to examine large-scale variation and similarity of personality traits is to compare groups of people living within a single nation. Rentfrow and Jokela (2016) refer to this approach as *geographical psychology*. Although citizens share some environmental influences, such as a political system and institutions that govern and influence their daily lives and experiences, there is regional variability in people's attitudes and beliefs. Psychologists might also explain these differences in terms of personality traits. A cattle rancher and a software engineer might have difficulty maintaining a prolonged conversation. But why? What causes people to cluster in different geographic locations? One obvious reason is that people are born into a location and may not have the means to make any changes, even if they wanted to. In addition, people tend to cluster in geographic regions because social influences help establish what is "normal" or expected of people, and relocating would therefore go against social, moral, or political beliefs. Ecological features of the local environment also influence where people live. For example, University of British Columbia psychologist Mark Schaller reported that people who live in areas where disease risk is high show elevated levels of conscientiousness and low openness (Schaller & Murray, 2008). Furthermore, for people who have the resources to relocate, their destinations tend to be ones that reinforce existing personality characteristics (e.g., someone raised in an urban setting will likely relocated to another urban setting).

How Genes Affect Personality

Listen to the Audio

Cultural influences on personality would clearly fall on the “nurture” side of the nature–nurture continuum. In this section of the module, we will examine personality from a different perspective: genetics. We all know that we can inherit physical traits from our parents. But can you be born with your mother’s sense of humour or your father’s agreeableness? And, is it possible to separate the contribution of your genes from that of your upbringing?

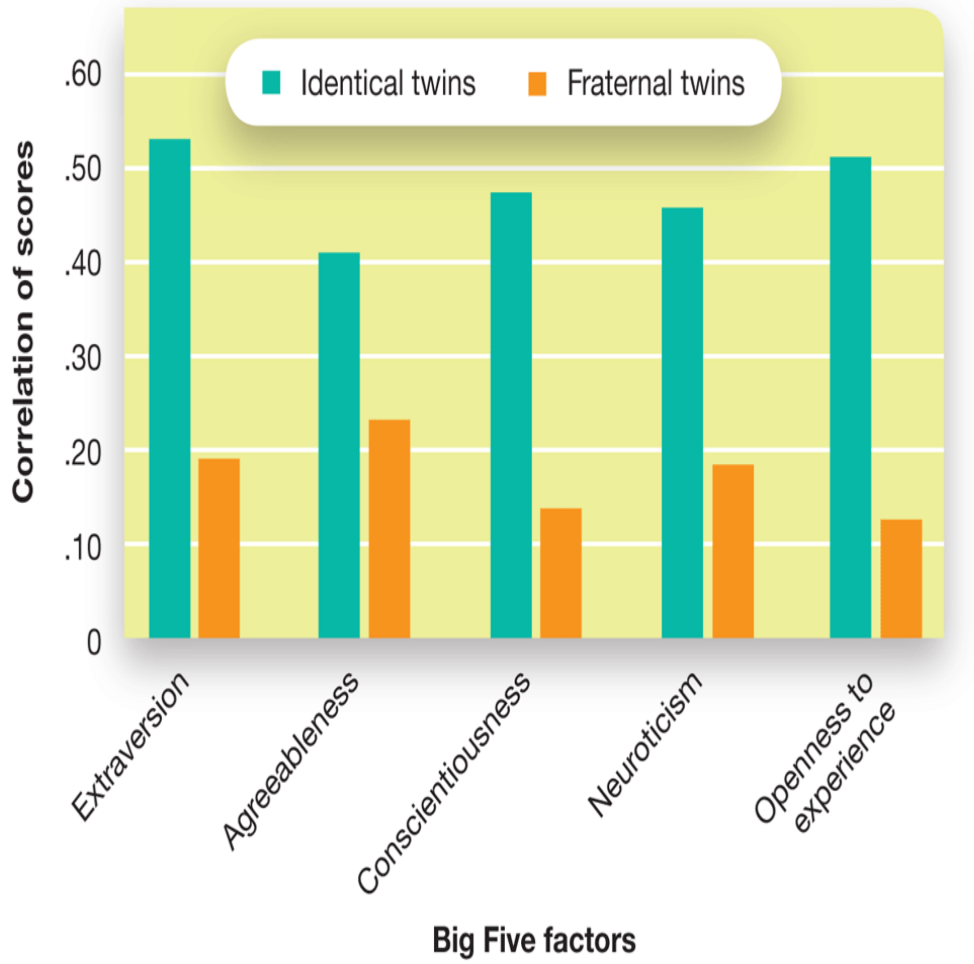
Twin Studies

Listen to the Audio

Researchers attempting to tease apart the contributions made by our genes and our environments faced a key challenge, which was that families share not only genes, but also many environmental factors. For example, if you were to observe a behaviour pattern that runs in families, such as alcoholism or anxiety, you might be tempted to conclude that because of the strong family inclination toward this pattern, there must be genetic roots. But family members also often live in the same home, share many experiences together, and are exposed to many of the same stresses and other circumstances. How then do you know if the pattern you observe is due to the shared genes or the shared environments?

The use of twins as research subjects was a brilliant way of overcoming this challenge (see Module 3.1). Comparing twins who were identical (monozygotic) to twins who were fraternal (dizygotic) allowed researchers to estimate the influence of genetic factors on personality (Figure 12.4). Research on the Big Five personality traits of twins has shown that identical twins show a stronger correlation for each personality trait than do fraternal twins. The correlations for identical twin pairs are approximately .50 for all five factors, significantly higher than the correlations for fraternal twin pairs (who average approximately .20). This implies that the increased similarity in the personalities of identical twins is due to their shared genes.

Figure 12.4 Genes and Personality



Identical twin pairs show higher genetic correlations than do fraternal twins for each of the Big Five personality traits. Numerical estimates of genetic correlations differ depending on the populations sampled, but studies typically show a genetic basis for each of the five factors (Bae et al., 2013).

But, you might ask, how do researchers know that it's the increased genetic similarity of identical twins that is responsible for their similar personalities? Maybe identical twins also tend to share more similar environments than fraternal twins, and this is the reason for their personality similarity. Identical twins are often treated in very similar ways, especially during their younger and formative years. If this is true,

then the strong correlations between identical twin pairs might be environmentally based.

An impressive line of research directly examines this question. The Minnesota Study of Twins Reared Apart located over 100 sets of twins and triplets who were raised in separate households, and compared them to those raised in the same household. Amazingly, identical twins raised *in different households* are about as similar to each other as identical twins raised in the same household! In fact, fraternal twins who are raised in the same home are actually more different from each other than identical twins who are raised in completely different families (Bouchard et al., 1990; Tellegen et al., 1998).

Other studies of adopted children support these findings. On average, the personalities of adoptive parents have no influence on the personality characteristics of their adopted children. Although it may be hard to believe, siblings who are adopted (i.e., not genetically related) and raised in the same household are *no more similar in personality than two people picked randomly off the street* (Plomin & Caspi, 1999). The genetic influences on personality are strong indeed (see Module 3.1 for further discussion of the genetic contributions to behaviour).

It is important to note that this does not mean that parents are incapable of influencing their children's personality development. Obviously, parents who abuse their children, or on the positive side, parents who put extraordinary efforts into cultivating positive personality traits in their children, are likely to have an impact on their children's personalities. Knowing that a trait is statistically associated with genetic factors tells you virtually nothing about the extent to which a specific person could be affected by a specific set of environmental conditions. Parents can, of course, have positive or negative influences on their children's

development, and it is important not to deemphasize this when examining biological and genetic studies.

Watch Twins and Personality

One further challenge of this research is to move beyond estimating the overall heritability of traits, and begin to uncover which specific genes are linked to personality outcomes. New advances in gene sequencing techniques and molecular genetics methods are allowing scientists to do just that.

Gerald Levey and Mark Newman are identical twins who were reared apart. When they eventually met, they had many similarities—for example, both chose the same profession, loved John Wayne movies and *The Three Stooges*, and had a fondness for professional wrestling.

AP Images

Working the Scientific Literacy Model

From Molecules to Personality

Listen to the Audio

It's pretty mind-blowing to know that who you are was determined to a fair degree before you were even born, by whatever genes you happened to inherit from your parents. Researchers are just beginning to piece together which specific genes influence which traits.

What do we know about specific genes and personality?

Although scientists have not identified a specific gene or genes involved in the expression of specific personality factors, such as neuroticism or agreeableness, they have discovered genes that code for specific brain chemicals that, in turn, are related to personality. For example, one of the genes that codes for serotonin activity has been found on human chromosome 17. Specifically, this gene codes for proteins that transport serotonin molecules within the tiny spaces (synapses) between nerve cells. Many of our genes are polymorphic (*poly* = "multiple"; *morph* = "form"), meaning that there are different versions of the same gene that lead to different physical or behavioural characteristics. Two possible variations of the "serotonin transporter gene" have been identified: a short copy and a long copy.

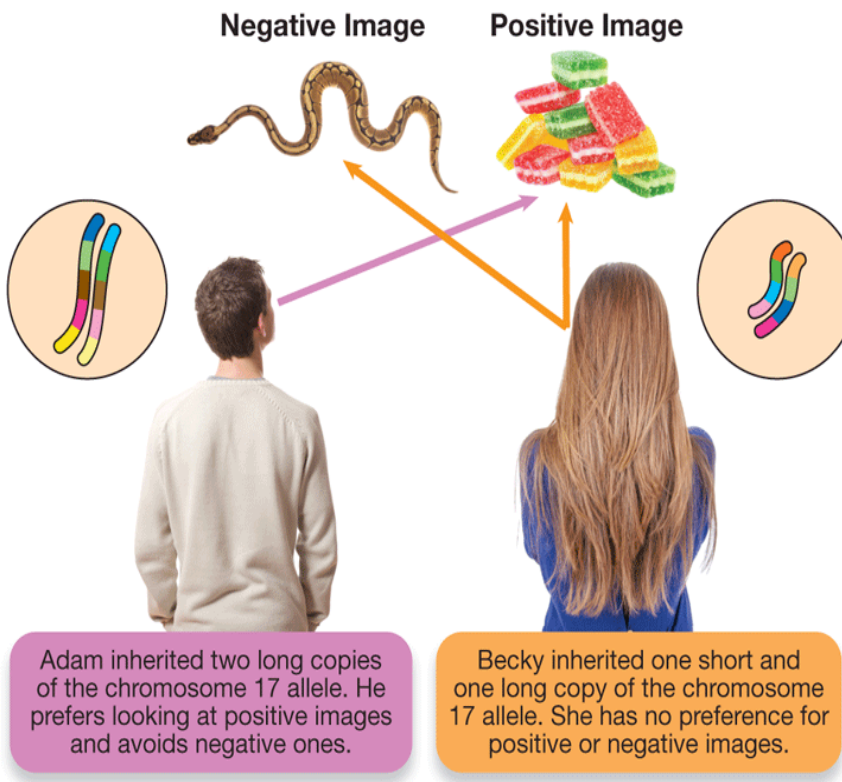
How do scientists study genes and personality?

To study genes and personality, one method is to compare responses on self-report questionnaires of people who have inherited different copies of a specific gene. People who inherit short copies of the serotonin transporter gene from one or both parents seem predisposed to anxiety, shyness, and experiencing negative emotional reactions in interpersonal situations (Battaglia et al., 2005; Lesch et al., 1996). However, other researchers have suggested that these differences may depend on which of the many different varieties of self-report questionnaires are used (Schinka et al., 2004).

Another method for studying genes and personality is to conduct experiments and compare the responses of people with different copies of a gene. In one study, participants provided a hair sample so researchers could extract DNA to determine which combination of serotonin transporter genes they had inherited. The participants completed a task that monitored their attentional focus to pictures of positive (e.g., a smiling infant), negative (a black widow spider), or neutral (a kitchen table) stimuli. Previous research has shown that people who have problems with anxiety focus their attention on threatening stimuli more than non-anxious people (Bar-Haim et al., 2007). Researchers found that participants who had inherited two long copies of the gene were biased toward looking at positive images more frequently and for longer periods of time. On the other hand, people who inherited one or two short versions of the gene spent more time looking at negative images (Figure 12.5; Fox et al., 2009). It seems that inheriting short copies of this gene increases anxiety levels in general, and seems to steer people

toward giving excessive attention to negative and threatening information.

Figure 12.5 Genes, Serotonin, and Personality



People who inherit two copies of the long version of the serotonin transporter gene fixate on positive images and avoid looking at negative images. People who inherit the short version of this gene are not biased toward attending to positive imagery.

Can we critically evaluate this evidence?

It is important to keep in mind that, in most cases, there is no single gene causing a single outcome in a person. Most phenomena are understood to be caused by multiple genes interacting with the environment, a process known as *epigenetics* (see Module 3.1). For example, physiological and psychological responses to stress in the environment can affect how certain

genes, like the serotonin transporter gene, respond in future stressful situations. Currently, the general consensus is that a vast number of genes, each of which has only a very small effect, account for individual differences in personality (Terracciano et al., 2010). Finally, it is also important to note that these are correlational studies, and inferring causality from such data is highly problematic.

Why is this relevant?

Knowledge about how genes and personality are related can help psychologists identify risk factors for developing mental disorders. As we will see in other parts of this text, genetic studies of personality help us better understand the biological basis of psychological disorders such as anxiety and depression. This work raises some interesting possibilities, such as the potential to screen individuals to assess their risk of developing a disorder. In turn, at-risk individuals might be better helped with early detection and treatment. Also, knowing about the genetic underpinnings of personality is highly informative to theorists seeking to understand how our personality traits, and the variability of traits across cultures, evolved in the first place.

The Role of Evolution in Personality

Listen to the Audio

Evolutionary psychologists emphasize that our personality structures are built right into our species because they conferred selective advantages to humans possessing certain traits. But the human species is related to other species as well, and so one would expect that we may share at least some aspects of our personalities with other species.

Animal Behaviour: The Evolutionary Roots of Personality

Listen to the Audio

One compelling argument for the usefulness of the evolutionary perspective on personality is the presence of personality traits in numerous nonhuman species (Weiss, 2018). For example, scientists have studied one particular species of bird (*Parus major*) that lives in Europe and Asia. These birds display two different patterns of behaviour when they encounter new environments, corresponding to a "fast-exploring" or "slow-exploring" personality type. The fast-exploring types are aggressive and bold in their exploration of new environments, and tend to rely more on routine ways of responding to the environment rather than being responsive to external cues. The slow-exploring types are passive, shy when confronted with new environments, and more responsive to the external environment, changing their behaviour more readily to suit changes in the environment. These two personality types are known to have a strong genetic basis. Which of the two personality types is adaptive depends on what kind of year the birds are having. If there are limited resources, aggressive, fast-exploring females, and timid, slow-exploring males have greater reproductive success. In years where resources are plentiful, it is the opposite—slow-exploring females and fast-exploring males have greater success. There are complex reasons why males and females have personality factors that are oppositely adaptive to the environment, but the important point is that the basic personality dimension of aggressiveness vs. passivity is represented in

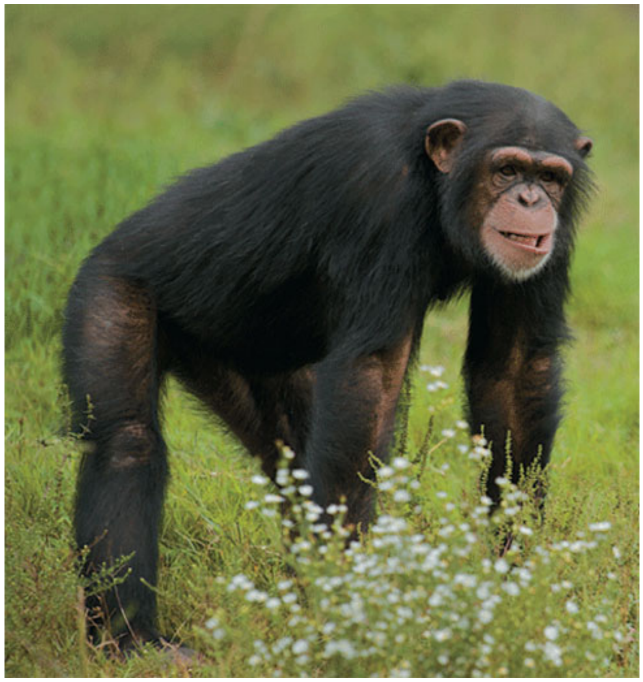
these birds and has been clearly tied to the birds' adaptive advantage in different environments (Dingemanse et al., 2004).

The suggestion that animals have personalities may not strike you as all that surprising. Many people who have had close and extended experience with animals, from farmers to pet owners, would say that animals have personalities. For example, dog lovers don't feel that their pet is a totally incomprehensible beast; instead, they attribute qualities, emotions, and personality quirks that are very "human" to the beloved animal. This may merely illustrate our tendency to anthropomorphize the living world, seeing other species through our own egocentric lens, but it may also reflect our shared genetic heritage with other species.

Researchers who wish to study animal personalities face a daunting task, particularly considering that nonhuman animals are usually not very adept at filling out personality scales. To overcome this problem, one approach for measuring the Big Five factors in animals was for individuals who are familiar with the animals to rate their behaviours according to the five factors. Typically, observers strongly agree on their ratings of extraversion and neuroticism in animals (Gosling, 2001). In fact, several of the Big Five personality traits have been found in a rich diversity of species—such as rhinos, primates, hedgehogs, and even ants (Gosling, 2001)! In one study of chimpanzees, our closest primate relatives, a list of adjectives was taken from the Big Five test and people who were familiar with the chimpanzee subjects rated how well the adjectives applied to each chimp on a scale of 1 to 7. Of the Big Five traits, extraversion, conscientiousness, and agreeableness were reliably found in the chimps (Weiss et al., 2007).

Poeticpenguin/Shutterstock

Rena Schild/Shutterstock



Michael Nichols/National Geographic/Getty Images

Psychologists are finding that measures of human personality are applicable to diverse species such as hyenas, octopuses, and chimpanzees, among many others.

The presence of basic personality dimensions may be extremely widespread in the living world; some researchers even argue you do not need a backbone to have a personality. Researchers at the University of Lethbridge, Alberta, have shown that octopuses show stable individual differences in measures of activity, reactivity, and avoidance (Mather & Anderson, 1993).

Why There Are So Many Different Personalities: The Evolutionary Explanation

Listen to the Audio

David Zuroff of McGill University argues that evolutionary perspectives can make a major contribution to our understanding of personality, helping us to understand why we acquired the specific traits that we did (Zuroff et al., 2010). This question is left largely unaddressed by most personality theories, which focus on content (e.g., What personality traits are there?) rather than on process (e.g., Why do we have these traits in the first place? What functions do they serve?).

Evolutionary perspectives can help us to understand *why* humans have evolved the particular personality traits that we have (Buss, 2009). To the extent that the Big Five traits are built right into our biology, these traits must have been selected for by being adaptive in past evolutionary epochs, helping to promote our survival and reproductive success. Furthermore, variation in how personality is expressed might reflect different responses to fluctuating physical and social environments. If a population of people rigidly behaved in the exact same way, their chances of survival would diminish if the environment changed. Therefore, individual variation in personality allows populations to respond to environmental change.

For example, individuals high in extraversion would be more likely to rise in social hierarchies, playing leadership and social networking roles in a community; on the other hand, extraverts tend to be risk takers and

sensation seekers, which means that introverts can readily co-exist alongside introverts and exploit the downsides to being extraverted. People high in conscientiousness would be reliable and dependable, and others would learn to count on them to get things done, clearly desirable qualities in a mate. However, the person low in conscientiousness may be an attractive partner to mate with for other reasons, such as their spontaneity and willingness to not always take life too seriously.

People low in neuroticism would be the emotional stalwarts of the community, the people who didn't crack under pressure but kept a level head and could be counted on in crises. However, being high in neuroticism could pay off at times; for example, highly neurotic people could have benefitted in terms of survival by being more attuned to danger. People high in agreeableness would be the friends who are there for you when you need them, and they would generally help to promote harmony and solidarity as groups work together on larger projects; whereas those low in agreeableness might, because of their lower tendency to conform, stumble upon new and successful solutions to novel and potentially harsh problems encountered by ancestral humans. People high in openness would be imaginative and creative, helping to build bridges between members of different subgroups in the community, and challenging ideas so that the community doesn't rigidify into dogma and closed-mindedness. On the other hand, those low in openness may be useful for preserving traditions and helping to identify a coherent sense of identity within the community.

As you can see, being either high or low in each Big Five trait could be desirable, depending on the situation. Thus, the complex blends of personality types across society evolved because different traits were desirable in different circumstances. Just as there are different niches to which animal species adapt in an ecosystem, there are different social niches to which people can adapt in society. The extravert and the

introvert, the neurotic and the secure, the conscientious and the careless gravitate toward the respective niches they best fill.

Given that specific traits have certain strengths and weaknesses, it seems likely that the different traits evolved because a mixture of traits with complementary strengths and weaknesses would be advantageous at the group level, if not necessarily at the individual level. In other words, to understand why we evolved the traits that we did, we have to consider traits not operating in isolation but, instead, operating at a more communal level.

Myths in Mind

Men Are from Mars, Women Are from Venus

Much is often made about apparent differences in how men and women think and behave. This comparison can sometimes get stretched pretty far, such as the implication inherent in the title of the 1992 self-help book *Men Are from Mars, Women Are from Venus* (Gray, 1992). The notion that men and women may as well be from different planets is strongly reinforced by the popular media.

To what extent does science back up this hypothesis when it comes to personality? On the one hand, there is strong evidence that men and women differ on their Big Five personality ratings. Women generally report higher levels of extraversion, conscientiousness, agreeableness, and neuroticism than men. This finding has been noted in comparisons made across dozens of cultures (Schmitt et al., 2008). On the other hand, these gender differences are quite small, and are vastly overwhelmed by the variability *within* each

gender. In other words, there are a lot of men who seem like they're from Venus, and a lot of women who seem like they're from Mars. So, even though there may be a gender difference in personality, it is so small as to hardly allow the characterization that men and women are fundamentally different from each other (Shibley-Hyde, 2014).

In an interesting twist, however, this research also found that the gender differences are related to economic factors. Specifically, the countries showing the *largest* gender differences in personality also have greater access to resources such as health care, education, and wealth. Men and women in countries with fewer social and economic resources tend to be more similar in their self-reported personality scores. This phenomenon may occur because a lack of resources tends to constrain the behaviours and social roles of individuals, thus making people more similar to each other at the expense of their personal individuation. On the other hand, abundant prosperity opens up more opportunities for personal expression and allows individual differences to flourish (Schmitt et al., 2008).

The conclusion seems to be that men and women do have different personalities, on average. Nevertheless, the differences are so small that Mars and Venus must be pretty similar places, so to speak. A good title might sell a lot of books, but does little to inform the general public about what scientific studies truly reveal about human behaviour.

In the final section of this module, we examine biological explanations for our personality traits. Can differences in the volume of brain structures or

the activity of brain regions explain, at least in part, why personalities vary?

The Brain and Personality

Listen to the Audio

Modern biological approaches for investigating the brain and behaviour build on many ancient traditions of medicine that connected the mind to the body and sought to understand the person in terms of bodily processes. For much of the past 2000 years, Western medicine was guided by the theory of **humourism**, *which explained both physical illnesses and disorders of personality as resulting from imbalances in key fluids in the body*—the four “humours” (see Module 1.2). In the late 1700s and into the 1800s, early psychologists promoted **phrenology**—*the theory that personality characteristics could be assessed by carefully measuring the shape of the skull*. However, these early biological approaches have long since fallen out of fashion, and the field has made major strides in understanding actual biological systems that are involved in personality processes.

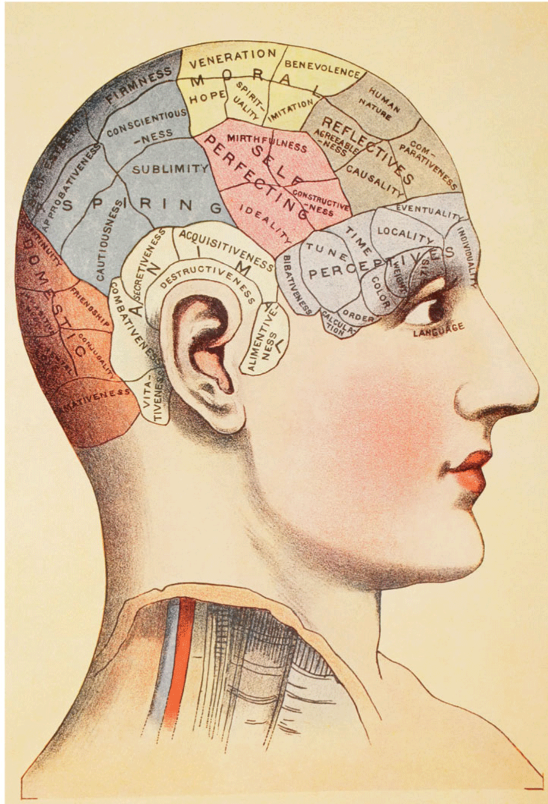
Extraversion and Arousal

Listen to the Audio

A big step forward occurred in the mid-20th century, when researchers began convincingly linking personality characteristics with specific brain systems. One of the most influential pioneers in this field, Hans Eysenck (1967), proposed an **arousal theory of extraversion**, *arguing that extraversion is determined by people's threshold for arousal*; according to this theory, people high in extraversion (i.e., extraverts) have a higher threshold for arousal than people low in extraversion (i.e., introverts). As a result, extraverts generally seek greater amounts of stimulation, whereas introverts seek to limit the amount of stimulation they experience so as to not become overwhelmed with excessive arousal. One brain system, the **ascending reticular activating system (ARAS)**, *plays a central role in controlling this arousal response*. Research on Eysenck's ideas has demonstrated that extraverts do have less reactive ARASs compared to introverts. Put simply, for a given "kick," introverts have a stronger response, which is why introverts tend to avoid excessive stimulation, whereas extraverts tend to seek it out. Work done since Eysenck's studies of arousal and extraversion has painted a more complex portrait. In addition to the reticular activating system, there are other brain systems that contribute to arousal, such as the circuitry involving neurons that release dopamine, serotonin, and norepinephrine (Trofimova & Robbins, 2016). With the benefit of hindsight this isn't that surprising. Something as complex as personality isn't going to be reducible to any single brain region or chemical.

Another influential model of the brain–personality relationship was proposed by Jeffrey Gray, whose approach/inhibition model of motivation (Gray, 1991) describes two major brain systems for processing rewards and punishments: the behavioural activation system and the behavioural inhibition system.

The **behavioural activation system (BAS)** *is a "GO" system, arousing the person to action in the pursuit of desired goals*. This system is responsive to rewards and fairly unresponsive to possible negative consequences; greater BAS activation therefore is associated with greater positive emotional responses and approach motivation. The other system, the **behavioural inhibition system (BIS)**, *is more of a "danger" system, motivating the person to action in order to avoid punishments or other negative outcomes*. The BIS is therefore associated with greater negative emotional responses and avoidance motivation. The underlying theory of BAS and BIS is supported by individual differences in brain activity that support approach and avoidance responses. For example, people with strong tendencies toward behavioural activation have strong connections between brain circuits that support movement toward goals (the basal ganglia) and a region of the prefrontal cortex that computes the value of a rewards (Gourley et al., 2016).



Phrenologists believed that different personality traits were housed in different regions of the brain.

Classic Image/Alamy Stock Photo

As you might expect, several of the Big Five factors are correlated with activation of the BIS/BAS systems. The most consistent finding is that extraversion is especially related to BAS activation, whereas neuroticism is related to BIS activation (e.g., Gomez et al., 2000). This evidence is beginning to build at different levels of analysis, but it takes a long time for such complex studies to accumulate. However, just considering the link between extraversion and BAS activation, we can see data focused on at least three levels of analysis: behavioural, neurochemical, and emotional. For example, extraverts tend to act impulsively when presented with the possibility of rewards, even ignoring the risk of punishment (Patterson & Newman, 1993). Extraverts show a stronger dopamine response to rewarding stimuli (Depue & Collins, 1999). And

extraverts tend to experience more positive emotions in a range of situations (Ashby et al., 1999; Lucas et al., 2000). Thus, a trait measure of extraversion reflects the functioning of many different systems, providing a great example of the integration of science across many areas of study.

As you have learned in previous chapters, there are all kinds of high-level technological advances, such as brain imaging, that can be used to answer previously unanswerable questions. Indeed, it seems that no stone goes unturned when it comes to implementing brain scanning technology to reveal the brain basis for a multitude of psychological characteristics. Such is the case with personality. Why not give participants brain scans and the Big Five inventory and see what happens? What areas of the cerebral cortex or limbic system (functions in emotional processing) are different (e.g., larger) in people who are conscientious or neurotic? This approach has been tried (DeYoung et al., 2010), but what we end up with is closer to phrenology than rigorous neuroscience. We may never know how to precisely "map out" the Big Five onto the brain. Expecting brains containing billions of nerve cells and connections to conform to a few general traits that emerge from self-reports about personality might be unrealistic.

Current knowledge about brain circuitry and function can, however, help us understand how specific aspects of personality and brain function interact. For example, extraverts generally show less activation in the amygdala than introverts (Canli et al., 2002). The medial orbitofrontal cortex is involved in processing reward, which is consistent with extraverts' greater reward sensitivity (i.e., strong BAS). The amygdala, on the other hand, is involved in processing novelty, danger, and fear, which extraverts tend to pay less attention to (i.e., weak BIS), hence their *under*active amygdalae (see Figure 12.5).

With regard to neuroticism, the dorsomedial prefrontal cortex is involved in regulating emotions (Ochsner & Gross, 2005), the hippocampus in controlling obsessive negative thinking (Gray & McNaughton, 2000), and the mid-cingulate gyrus in detecting errors and perceiving pain—whether physical or emotional pain (Carter et al., 1998; Eisenberger & Lieberman, 2004). These are the kinds of processes that define highly neurotic people. They have difficulty controlling their emotions, often fall prey to obsessive negative thinking, and are highly sensitive when they make mistakes or feel pain.

Individuals high in openness to experience have been shown to have greater activation in the dorsolateral prefrontal cortex, which is involved in creativity and intelligence, as well as other brain systems involved in the integration of the self and the environment (Adelstein et al., 2011). These systems reflect the tendencies for people high in openness to be creative, integrative thinkers.

Although the ability to link brain regions to personality processes at such a refined level has only become possible recently, neuroscientists are beginning to find brain regions that differ reliably between people with different personality traits. This does not mean that these brain differences *cause* the personality differences, but it does suggest that these brain regions are involved in serving neurological functions that are related to personality processes at some level. The causal connections might be indirect and highly varied, challenging us with incredible complexity, both of personality itself but also complexity of the neurological architecture of the brain. This complexity reminds us that in most cases, there will be no specific brain area involved uniquely in a personality trait; for example, there is no "centre of extraversion" in the brain. Any trait plays itself out through many different thoughts, feelings, and behaviours, each of which involves many different brain systems.

What seems like a stable pattern that we identify as a personality trait actually reflects activity in a number of different brain systems.

So we may never be able to point at a single region (or even a few regions) and declare it to be the centre of any single personality trait. That said, we have come a long way from the days when personality was described in terms of the four humours of blood, phlegm, and black and yellow bile.

Module 12.2 Summary

Listen to the Audio

12.2a Know . . . the key terminology associated with cultural and biological approaches to personality.

Review Module 12.2

Start Over Swap

0/7 REVIEWED · 0 MASTERED

phrenology

Previous Next Got It!

12.2b Understand . . . how evolutionary theories explain personality.

Evolutionary psychologists theorize that personality traits evolved because they solved environmental and social problems encountered by

our distant ancestors. Although this hypothesis is difficult to test directly, different sources of evidence lend support to it. The widespread occurrence of these personality traits among different species indicates that they are adaptive.

12.2c Apply . . . your knowledge to arrive at accurate conclusions about the influences of biological and cultural factors on personality.

Apply Activity

Test your knowledge about some of the major findings about personality that were discussed in this module. Identify whether the following statements are true or false.

1. Most research on personality surveys humans across all nations, ethnicities, and cultural backgrounds.
2. Personality profiles of people from different regions of the same country probably exist because of genetic differences among populations.
3. Based on evolutionary theory, personalities vary among individuals because fluctuating social and physical environments would favour different personality types.
4. Personality traits such as extraversion and openness cannot be traced to a single brain region responsible for their expression.
5. Enduring personality traits, such as those measured in the Big Five, are uniquely human.

12.2d Analyze . . . claims that males and females have fundamentally different personalities.

Claims of major sex differences in personality are sometimes made to support popular-book sales. In reality, the general consensus in

psychological science is that males and females are more alike than different when it comes to personality. Both, of course, share common personality dimensions. Although females tend to be, on average, more conscientious, agreeable, extraverted, and neurotic than males; these differences are very small, and there is no evidence to support claims that men and women are fundamentally different in personality.

12.2e Analyze . . . the genetic basis of personality.

Heritability studies show that personality traits are substantially predicted by genetic variation. Studies of twins and adopted children also back this up, showing that identical twins are far more similar in personality than fraternal twins, and that the home in which people grow up has much less influence over their personalities than the genes they inherited from their biological parents. However, despite this evidence for genetic influences on personality, we cannot conclude that personality is "hard-wired" and therefore unchangeable. Personality emerges through the interaction of genes and the environment; thus, a given genetic make-up can express itself differently in different environments.

Module 12.3 Psychodynamic and Humanistic Approaches to Personality

Listen to the Audio

blas/Fotolia

Learning Objectives

12.3a Know . . . the key terminology related to the psychodynamic and humanistic approaches to personality.

12.3b Understand . . . how people use defence mechanisms to cope with conflicting thoughts and feelings.

12.3c Understand . . . the developmental stages Freud used to explain the origins of personality.

12.3d Apply . . . both psychodynamic and humanistic perspectives to explain personality.

12.3e Analyze . . . whether projective tests are valid measures of personality.

12.3f Analyze . . . the strengths and weaknesses of psychodynamic perspectives.

Abraham Maslow, who was introduced in *Module 11.3**, was fascinated by people who actually live up to their potential. Many of us want to follow today's pop-culture slogans to "live for the moment," "be all that you can be," and "do one thing every day that scares you"—but somehow, most of us never quite get around to it. Perhaps you've experienced that nagging feeling that life is passing you by and the epic adventure you thought your life was going to be is somehow more mundane than you'd hoped? Apparently, this doesn't happen to everybody; some people really do seem to live inspiring and fulfilling lives, and these were the personalities that Maslow wanted to understand.*

In striking contrast to much of the cynicism of the 20th century, Maslow believed that although we have the capacity for great evil, at

the very foundation of our being we are inherently good. He argued that the more we open ourselves to our inherent goodness, the more we will see reality clearly, rather than through our biases; the more we will be empowered and able to confront life courageously, rather than shrinking from challenges because of our insecurities; and the more we can focus on helping others rather than tending to our own needs and wants. The end result of pursuing personal growth is to become fully, vibrantly alive.

Labouring under the effects of deficiency motivation is like looking at the world through a clouded lens, and removing those effects is like replacing the clouded lens with a clear one. Self-actualizing persons' contact with reality is simply more direct. And along with this unfiltered, unmediated directness of their contact with reality comes also a vastly heightened ability to appreciate again and again, freshly and naïvely, the basic goods of life, with awe, pleasure, wonder, and even ecstasy, however stale those experiences may have become for others. (Maslow, 1968)

Is it possible to live such a life? Maslow thought so, and personality researchers are still following his call and trying to decipher the magic ingredients that allow some people to truly thrive in life.

Maslow hoped that his work would help people learn how to cultivate these qualities within themselves. His optimistic vision of human nature was a major break from the personality psychology of the day, which largely grew out of a Freudian psychodynamic perspective. As we discuss in the text that follows, to the Freudians, personality was a battleground between opposing forces in the psyche, as people struggled to defend themselves against the negativity that loomed in their unconscious. In contrast, Maslow and the humanists explored a positive, growth-oriented side to personality that we need to fully appreciate in order to have a more complete picture of the human personality.

Although neither Freudian psychoanalysis nor Maslow's humanistic theories have retained their once-prominent positions in psychology, they remain highly influential approaches in society at large, and have inspired and guided generations of people to live their lives more fully.

The Psychodynamic Perspective

Listen to the Audio

As one of the best known and most influential psychologists of all time, Sigmund Freud often does not get the respect you might think he would deserve. Many of his theories have not stood the test of time and are now largely ignored. Several are difficult or impossible to integrate with more modern approaches, such as social-cognitive and neuroscience perspectives. Indeed, some of his theories are even regarded as ridiculous by many people (e.g., the Oedipus complex, discussed later in this module). Freud was definitely a colourful character. He was a passionate user and advocate of cocaine before its addictive and destructive properties were known. He was rumoured to have been tyrannical toward his followers, allowing people to express little dissent from his views. Freud has been critiqued as having an obsession with sex, as having created unfalsifiable and therefore unscientific theories, and as using only a limited cross-section of humanity (mostly women seeking counselling in Victorian-era Europe) upon which to base rather grand and sweeping theories about human nature.

However, despite the criticisms, Freud was a pioneer in the study of personality and the treatment of psychological disorders. He laid much of the foundation for our basic understanding of consciousness, which is still with us today, as are many of his key insights. When a drug addict admits to being “in denial” of his addiction, an abuse survivor talks about how she “repressed” her memories and feelings for many years, or someone

accuses you of “projecting” your anger onto other people, they are expressing Freud’s ideas.

Interestingly, Freud was not trained in psychology, but was instead a neurologist. The launch of his scientific career was anything but glamorous; he spent many hours peering through microscopes at tissue samples, searching for the elusive testicles of the male eel, which had not yet been discovered. Freud’s extraordinary attention to detail, along with the unwitting cooperation of many hundreds of eels, led him to eventually make the discovery. Which might make you ask, what kind of person exhaustively searches for eel testicles? No doubt, Freudian theorists would have an interesting answer to that question.

After leaving his scientific career to be trained as a physician, Freud began to accept clients who sought his help for psychological difficulties. Initially, Freud believed that their issues could be resolved through investigating their physiology and isolating the biological factors that contributed to their problems. However, after examining some of his patients, he realized that their emotional struggles often could not be understood at the physiological level; instead, he had to delve into the mysterious depths of the mind. This led him to begin trying to understand the personalities of his patients and the psychological dynamics that led to the problems they were experiencing.

Over time, his observations and ideas coalesced into his *psychodynamic theory*, which isn’t really a “theory” at all, but rather an evolving family of different theories and ideas that share many key features, which we discuss in this module (also, see Westen, 1998).

Assumptions of Psychodynamic Theories

Listen to the Audio

A universal assumption of psychodynamic theories is that personality and behaviour are shaped by powerful forces in consciousness, a great deal of which is hidden from our awareness in the mysterious unconscious. By emphasizing the unconscious, Freud threw into doubt many of our common feelings and beliefs. For example, we like to feel that we are in control of ourselves, and our behaviour reflects conscious choices that we make. We believe that we know why we do the things we do—that our behaviour makes sense to us. We also like to believe that when we do something embarrassing, immoral, or just plain stupid, that we were somehow "out of control" or that it was a mistake.

From a psychodynamic perspective, however, there are no mistakes, and we have very little control over ourselves and remarkably little insight into the reasons for our own behaviours. Everything we think, feel, and do results from psychological dynamics that are so deeply buried in our unconscious that we have no direct access to them; our mind is a "black box," even to ourselves.

To understand the implications of Freud's psychodynamic theory, we will explore its key concepts and how they apply to personality psychology.

Unconscious Processes and Psychodynamics

Listen to the Audio

Freud grounded his theories on a model of consciousness that distinguished between different levels of mental life, most importantly between the conscious mind and the unconscious. The **conscious mind** *is your current awareness, containing everything you are aware of right now*. The **unconscious mind** *is a much more vast and powerful but inaccessible part of your consciousness, operating without your conscious endorsement or will to influence and guide your behaviours*. The unconscious mind houses your full lifetime of memories and experiences, including those that you can no longer bring into conscious awareness, such as emotional patterns that were created in early childhood or even infancy. It also contains your preferences and desires, which can influence you in ways that may be obvious or in ways so subtle that you are not even aware of them. The relationship between these two levels of consciousness is often described using an iceberg metaphor of consciousness (see Figure 12.6). With icebergs, the part you can see above the surface is a small fraction of the entire iceberg, while most of its bulk lurks beneath the surface. Similarly, the conscious mind is a small fraction of the entire psyche, most of which lurks beneath the surface of our awareness in the depths of the unconscious.

The mysterious, vast, inaccessible unconscious is viewed as the primary driver of our behaviours, controlling us in countless ways. Even seemingly trivial behaviours, such as slips of the tongue, were argued to

reflect the workings of the unconscious. In fact, these slips, famously called “Freudian slips,” are very useful to the observant person, because they offer a glimpse into the unconscious. When people make a Freudian slip, their conscious mind intends to say something appropriate to the circumstances, but their unconscious mind leads them to say what they were “really thinking.” As the classic psychologist joke goes, “The definition of a Freudian slip: when you mean to say one thing but you end up saying a-mother.”

Freud believed fervently in the value of these “psychopathologies of everyday life” and developed several techniques that psychoanalysts could employ to use such small clues to gain access into the netherworld of the unconscious. (We revisit this later in this module.) Freud and other psychoanalysts argued that much of what manifests as personality reflects patterns that emerge as people attempt to resolve conflicts between their conscious and unconscious minds.

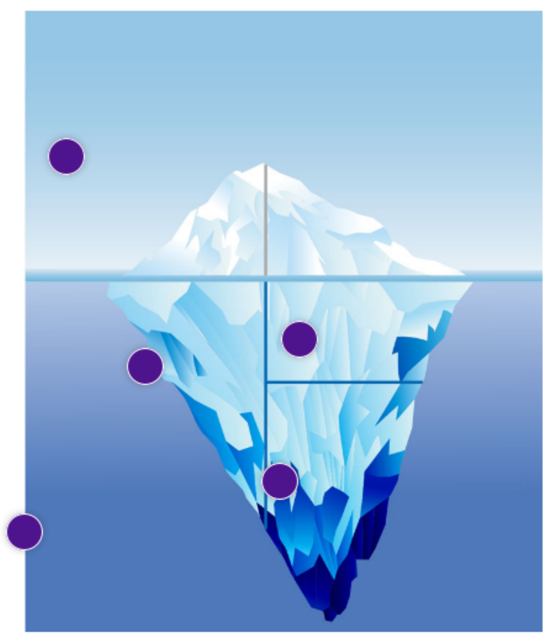
The Structure of Personality

Listen to the Audio

Have you ever done something you knew at the time was wrong? Like eating that brownie when you knew you shouldn't? Losing your temper? Hooking up with that attractive person even though they already have a boyfriend or girlfriend (or you do)? To explain this type of all-too-common conflict, Freud hypothesized that the human psyche consists of three basic structures, which are often in conflict with each other: the *id*, the *ego*, and the *superego* (Figure 12.6).

Figure 12.6 The Freudian Structure of Personality

Select the circles to reveal the structures of personality according to Freud.



A popular depiction of how Freud viewed personality features an iceberg, with the unconscious mind residing below the surface and conscious awareness at only the tip of the iceberg. The id is completely submerged, whereas the ego and the superego operate at both unconscious and conscious levels.

The **id** *represents a collection of basic biological drives, including those directed toward sex and aggression*. Freud believed the id was fuelled by an energy called *libido*. Although this term is more commonly used in reference to sexual energy, the libido also controls other biological urges such as hunger. The id operates according to the *pleasure principle*, motivating people to seek out experiences that bring pleasure, with little regard for the appropriateness or consequences of their realization. Because the id represents our basic animal desires, it is present right from birth and is the predominant force controlling our actions in the earliest stages of our lives. The id gets us into trouble though, and increasingly so as we get older, and society frowns on some of the unrestrained urges of our lusty animal selves. Because society imposes constraints on our behaviour, the id must be restrained from its animal nature; that is where the ego and superego come into play.

The **superego** *is comprised of our values and moral standards*. Our superego tells us what we *ought* to do, whereas the id tells us what our animal body *wants* to do. Freud believed that the superego forms over time as we become socialized into our family and larger community and we are taught the values and norms of our society. The superego represents a process of internalization, through which we adopt the values and standards of others and make them our own, and consequently, we feel good or bad about ourselves based on whether we think we are being "good" or "bad." When we behave immorally, the superego chastises us, similarly to how our parents may have done, thereby encouraging us to "do the right thing."

In between the devilish, indulgent id and the angelic, rule-bound superego sits the beleaguered **ego**, *the decision maker, frequently under tension, trying to reconcile the opposing urges of the id and superego*. The ego has to be plugged into reality; if it listened to the id all the time, we would be social deviants, instantly gratifying ourselves at every turn, but if it listened to the superego all the time, we would cut ourselves off from much of our raw passion and zest for life. The ego seeks to balance the two forces, operating according to what Freud called the *reality principle*. The id, ego, and superego are in constant tension, and it is this tension that gives rise to personality in two key ways.

First, different people's personalities may reflect differences in the relative strengths of their id, ego, and superego. You can easily imagine a person guided by an extremely strong superego versus a person guided by an extremely strong id. Indeed, these would likely be two completely different types of people. In this deep, structural sense, individuals' personalities are patterned by their own particular blend of ego, id, and superego. Each person's unique combination of biology (id), upbringing and sociocultural circumstances (superego), and their uniquely personal awareness and will (ego) ends up developing into their personality.

The second key dynamic that generates much of personality is how a person reacts to anxiety. Anxiety plays a huge role in psychodynamic thought, because anxiety is the experiential (what we feel) result of the tension among the id, ego, and superego. When these systems are out of balance, we experience the deprivation of one system as a kind of basic anxiety. This drives negative thoughts and feelings, which ideally would serve as messages to us—signals that "something is wrong; this system is not in harmony."

Anxiety can be about something huge and overwhelming (e.g., having abuse occur in a person's family) or about something mundane and

seemingly trivial (e.g., wearing the wrong thing to a party). But it's important to note that in either case, the anxiety itself has a kind of life of its own. For example, we can experience truly crushing and debilitating anxiety about something that others would think was silly (e.g., wearing the wrong thing to a party), whereas people can, through psychological defences (as we discuss shortly), defend themselves against even profound anxiety (such as being unwilling to face the reality of abuse occurring in the family).

According to Freud, the ego engages in anxiety defence throughout the day. From worrying about failing, to how we look, to whether someone likes us, to how something we did will be perceived by other people, we feel anxiety. We could wonder whether we made a good decision, feel guilty, wonder if we are losing our looks or our charm as we age, or deal with basically an infinite variety of potential things to worry about and feel badly about. Dealing with this constant drama is the job of the ego. And of course, there is its classic job, which is to figure out what to do when part of us wants to do the bad thing (whatever that may be), and part of us is scared or feels ashamed or otherwise knows we "shouldn't" do the bad thing.

It's easy to feel a bit sorry for the ego. Sure, it gets to be in control a lot of the time, but it also never really gets a break, always having to be on the job to keep us from becoming overwhelmed by anxiety. From Freud's perspective, consciousness is a constant battleground for the ego, negotiating between the id and superego, while also protecting itself from countless sources of anxiety.

Defence Mechanisms

Listen to the Audio

Oftentimes, the ego is unable to resolve the anxieties that plague it. Instead, it focuses merely on protecting itself from excessive anxiety, seeking some way of minimizing or avoiding the negativity it is experiencing. Imagine a young child caught between Mom and Dad screaming at each other. Having no way to resolve their conflict, they plug their ears and hide in the closet. The child can't resolve the negativity, so they try to escape it. This reaction is what the ego does when it employs its **defence mechanisms**, *unconscious strategies the ego uses to reduce or avoid anxiety* (Freud, 1936; see Table 12.3). In fact, the literal acts of plugging the ears and running into the closet are examples of *denial*, which is a very common defence mechanism.

Table 12.3 Examples of Some Major Defence Mechanisms

Table 12.3 Examples of Some Major Defence Mechanisms

Defence Mechanism	Definition	Example
Denial	Refusing to acknowledge unpleasant information, particularly about the self.	People deny all sorts of things—ways in which they are to blame for their relationship problems; bad things that other members of their family may be doing; dangerous behaviours, such as drinking while pregnant, that they may be engaged in; and truly, just about anything. Simply blocking distressing things from your mind can be a remarkably effective strategy (until it eventually comes back to haunt you).
Displacement	Transforming an unacceptable impulse into a less unacceptable or neutral behaviour.	After getting criticized by your boss at work, you go home and yell at your spouse or criticize your roommate for not doing more housework. One way or another, you "take out your anger" on a less dangerous target than your boss.
Identification	Unconsciously assuming the characteristics of a more powerful person in order to reduce feelings of anxiety or negative feelings about the self.	A child acts like their favourite hero-figure or an adult copies a trend-setting celebrity. By associating with a powerful, successful figure, they feel more powerful and successful too.
Projection	Perceiving in other people the qualities that you don't want to admit to possessing yourself.	The classic insecure, tyrannical parent, who sees hostility and "attitude" in other people, like his kids or his wife, thinking that other people are always seeing themselves as superior and are looking down their noses at others. Projection also allows us to see "evil" and aggression in our enemies while we invade and bomb them.
Rationalization	Attempting to hide your true motives (even from yourself!) by providing what seems like a reasonable explanation for unacceptable feelings or behaviours.	People who are prejudiced against certain types or groups of other people may not see themselves as racist, but may instead believe that the group they are prejudiced against actually does possess certain negative qualities. By believing that people from the disliked group are violent, or lazy, or unintelligent, the person never has to confront their own prejudice.
Reaction formation	Altering an impulse that one finds personally unacceptable into its opposite.	People who are judgmental and condemning of homosexuality, yet have homosexual impulses themselves. For example, homophobic men tend to have greater penile arousal, compared to non-homophobic men, when looking at male-on-male pornography (Adams et al., 1996).
Repression	Keeping distressing information out of conscious awareness by burying it in the unconscious.	Many people believe that victims of abuse or violence are sometimes able to *repress* their traumatic memories, essentially "forgetting" that the trauma occurred. Nevertheless, the trauma remains in their unconscious, causing them to react in ways that are driven by this unconscious material.
Sublimation	Transforming unacceptable impulses into socially acceptable or even pro-social alternatives.	Someone with a great deal of aggression may become a football player or a boxer. Freud believed that sublimation was one of the cornerstones of civilization, the mechanism by which base human desires were harnessed to give rise to great works of art, invention, and scientific advance. Sublimation operates to make you feel better by finding socially acceptable outlets for unconscious drives and urges.

Defence mechanisms play key roles in many important social phenomena, such as prejudice and discrimination. For example, imagine a CEO of a company choosing not to hire a member of an ethnic minority; the CEO may protect themselves from admitting the possibility that the choice was racially motivated by engaging in *rationalization*, reasoning that the applicant didn't seem as impressive, professional, or "like she will fit into our team." You can imagine the thought "It had nothing to do with race, of course! I just want to hire the best person for the job, and I felt that she wasn't the right fit. After all, I have a lot of

experience in this company, and I trust my sense of who is going to work out and who isn't." You can see how easily a person's own reasoning process can be hijacked by the ego in order to protect itself, and the line between what is true and what merely appears to be true can so easily be blurred.

Unfortunately, although defence mechanisms may keep us from feeling anxiety in the moment, they are ultimately dysfunctional for a variety of reasons. One is simply that undesirable tendencies are not confronted and problems are not dealt with; instead, immense energy is devoted to maintaining the defence mechanisms and trying to feel okay. For example, alcoholics (and often their families) sometimes go to great lengths to avoid having to admit that they have a problem, which only worsens the impact of alcohol on their lives. Freud's (and others') work on defence mechanisms remains influential to this day, particularly in the mental health field, where defence mechanisms often play important roles in therapy for psychological disorders.

Personality Development: The Psychosexual Stages

Listen to the Audio

Freud’s theory of personality also involved a sophisticated understanding of development. Freud believed that the personality developed as the person learned to channel the energy of the libido into appropriate forms of self-expression. Thus, to Freud, development of the infant and child is ruled by the id, involving the young child struggling to contain and channel sexual urges and feelings. The child is a bundle of animal impulses, and development is therefore based on the ego and superego developing properly through appropriate socialization experiences as the child grows up. Freud highlighted specific developmental challenges that children faced at different points of their lives, developing a stage theory of psychosexual development that tracked the progression children went through as they matured through the various stages (see Table 12.4).

Table 12.4 Freud’s Stages of Psychosexual Development

Table 12.4 Freud's Stages of Psychosexual Development

Stage	Pleasure Focus	Key Dynamics
Oral (0–18 months)	Actions of the mouth—sucking, chewing, swallowing	This stage is about the foundation of the ego. Fixation at this stage represents a basic lack of self-confidence and "ego-strength," leaving the person more dependent on, and therefore vulnerable to, external sources of support.
Anal (18–36 months)	Bowel elimination, control	This stage is about the development of a sense of control and competence. Fixation at this stage leads to an "anal retentive" or "anal expulsive" personality, manifesting either as an obsession with cleanliness, order, and control, or as a disorganized person.
Phallic (3–6 years)	Genitals	The key personality challenge is the Oedipus complex, through which a person further develops the superego due to the internalization of values from the parents. Fixation at this stage leads to problems with jealousy and obsessions with power and sex.
Latency (6 years until puberty)	External activities	Ideally, this stage is fairly conflict-free. People focus on developing themselves, discovering their interests through sports, arts, and general activities. Fixation at this stage was not considered to be a big concern.
Genital (puberty to adulthood)	Sexual activities with others	Ideally, this stage is also fairly conflict-free. People focus on fully and authentically engaging in the world, provided they are not fixated at earlier stages.

Interestingly, most of Freud's stages happened in the first five years of life, reflecting the central importance of the developmental milestones that occur in the first five years. At each stage, the libido manifests in particular areas of the body, depending on what areas of the body are most salient and important at that particular time of life. For example, as babies, sucking for food and comfort is a central activity, whereas for toddlers, learning to control the bowels and become toilet-trained is a pretty major focus; these physical challenges were reflected by Freud as specific stages (in this case, the oral and anal stages). When these bodily areas are relevant to the person, they become a focus for the id, which attempts to derive as much pleasure as possible from gaining gratification in those areas. Thus, each of these important regions becomes a battleground pitting the child's id against the restrictions of the external world.

If the child was able to release their libidinal energy appropriately through the part of the body that was relevant at that time, this would help them have a healthy relationship with themselves and they would be free to focus on the next stages of development. However, if their need satisfaction was thwarted or interfered with, they would become fixated at that stage. **Fixation** *involves becoming preoccupied with obtaining the pleasure associated with a particular stage as a result of not being able to adequately regulate themselves and satisfy their needs at that stage*. Fixation can occur either because of conflict and excessive parental interference (e.g., criticizing the child for making mistakes during toilet training), or because the child is allowed to overindulge in that form of pleasure-seeking behaviour.

The Oral Stage (0–18 months)

For babies, the mouth is where it's at; all the action that really matters happens through their mouths: feeding, comfort, teething, and even the early experiences of aggression. As a result, the mouth is a major focus for both pleasure and frustration, and the ego has to learn to satisfy the id's desire for biting and sucking with the superego's judgment about what is appropriate in a situation. If this goes well, the infant develops a basic sense of security and empowerment; this is the initial foundation for the ego.

However, if the infant either can't satisfy its need for security, comfort, or food, or conversely, if it is over-indulged so that it develops an emotional attachment to using its mouth, then it will develop an *oral fixation*. Instead of having a healthy ability to self-assert, the infant may develop to be dependent, have an addictive personality, and seek to "consume" the world for its own emotional needs. Fixating at the oral stage means that the person never fully develops their ego, and is therefore more vulnerable to anxiety and less capable at adjusting to social reality.

The Anal Stage (18 months–3 years)

Toddlers begin to become aware of themselves as separate individuals at the same time that they are gaining control over the bowels. Toilet training thus becomes the focal activity at this stage. Freud believed that if bathroom skills were learned successfully and positively with support and encouragement from caregivers, the result was a sense of competence and confidence that would lead the toddler to develop into a well-adjusted and productive adult. But if parents were too strict and critical of toddlers, making them feel bad about "having accidents" and putting too much pressure on them, they could become fixated at this stage, struggling with issues like shame and control. Eventually, they could become *anal retentive* adults, a rather rigid personality excessively concerned with cleanliness and order with a high need for control and little emotional openness. Or, if parents were too lenient and provided too little support for toilet training, this would produce an *anal expulsive* adult who exhibits opposite qualities of carelessness, disorganization, and general irresponsibility.

The Phallic Stage (3–6 years)

This early childhood stage is a crucially important stage in Freud's view, although this stage is also where people often find Freud's theories hard to swallow and many reject his ideas altogether. We believe it is worth considering what insights there may be in Freud's thinking, even if some of the specific details seem questionable. Also, keep in mind that the full development of Freud's theories is far more brilliant and detailed than what we are able to capture in a brief overview.

From ages three to six years, bodily attention shifts to the genitals as children become aware of the differences between boys and girls and start to heavily identify with one gender. Boys go through the now-infamous *Oedipus complex*. Freud theorized that in boys, the attachment

to the mother that was achieved during infancy (through oral means) now gets expressed in the phallus. He claimed that a boy in this stage become sexually attracted to his mother. The boy also realizes that he is in competition with his father for his mother's affections, which creates resentment toward the father and, in the wonderful logic of young children, makes the boy want to kill his father. During this stage, boys struggle with highly conflicted feelings toward their fathers, feeling both attached to and hostile toward them. This is a very difficult time emotionally, as boys are torn between such strong feelings and desires. Freud represents this anguish with the Greek tragedy of *Oedipus Rex* (by Sophocles). In this story, the main character, Oedipus, kills his father without knowing he has done so, and ends up marrying his mother. When he eventually learns what he has done, he is so overcome with horror that he stabs his own eyes, blinding himself. (The ancient Greeks were fairly intense.)

Freud used highly sexual language to describe the phallic stage, although it is important to remember that the literal descriptions can also be thought of as metaphoric insights into personality. According to Freud, little boys are quite distressed to learn that their mothers do not have penises. They reason that something must have happened to cut them off. And if that happened to their mothers, it might happen to them! Furthermore, it stands to reason that it was the powerful father figure who did the nasty deed, thus causing a great deal of *castration anxiety*, the fear of castration by their father. (Metaphorically, castration anxiety is the fear of emasculation.) Boys resolve this fear, and thus the Oedipus complex, by learning to identify with the father, developing a close bond with him, while repressing sexual feelings for the mother.

For girls, the logic was considerably more complicated and Freud revised his theories somewhat over time. Freud believed that girls also want to sexually possess their mothers and feel competition with their fathers.

When girls discover that they themselves lack a penis, they experience *penis envy*, which is pretty much exactly what it sounds like. As a result, girls redirect their sexual interest to their fathers, and subsequently men in general, because that's the way to get a penis. Having a child someday, particularly a boy, is also likely to be highly desired, because having a boy is (according to Freud) another way of obtaining a penis.

As mentioned earlier, Freud's theories are considered to be very deep and often profound, although it requires a lot of "unpacking" to get to those insights. For example, with regards to penis envy, you can take the penis as more of a symbol of power and masculinity, rather than as a literal penis. You can therefore take the envy of the penis to represent the female child's desire for empowerment, which she would gain through association with masculine traits and pursuits. When you think about it this way, you can see some potential merit to Freud's ideas. But for the most part, this part of Freud's theory has had little influence on the rest of the field. Also, we assume that the critiques of Freud's ideas about women are painfully obvious at this point. Indeed, these critiques of the phallic stage, as well as its general inaccuracy as a description of the psychological experiences of most people, have been devastating to this part of Freud's theories.

The importance of the phallic stage is that, at its resolution, the child has formed a healthy relationship with the parents, resulting in the internalization of parental values, which completes the formation of the superego. Successfully transitioning out of this stage leaves the child well prepared as a moral being. On the other hand, becoming fixated at this stage has striking negative consequences. People become plagued with jealousy and preoccupied with sex, seduction, competitiveness, and power.

Freud believed that girls never entirely resolve their Oedipus complexes (the term *Electra complex* was coined by Carl Jung but rejected by Freud), leaving women with somewhat less well-developed superegos and thus a less reliable morality. He theorized that to the extent that Oedipal issues remain, women will seek to control and dominate men through their sexuality or submissiveness because, of course, men have the penises that women envy.

The Latency Stage (6–13 years)

After the lurid sexuality and emotional drama of the phallic stage, the *latency stage* is downright boring. Between ages five and 13, the ego and superego have achieved a degree of general calm. The sexual nature of the libido is deemphasized, and it is instead directed into more productive activities than trying to mate with and murder one's parents, such as education, hobbies, and hanging out with friends. This is a period of rich personal development for children, during which they gain many of their intellectual, social, artistic, and physical skills. Interestingly, people don't get fixated at this stage, because personality is largely formed by the end of the phallic stage, and if people are not fixated at an earlier stage, they become relatively free to pursue their interests.

The Genital Stage

The onset of puberty marks the beginning of this stage, which continues throughout adulthood. This is the time during which the person emerges into a mature adult personality, with a fully developed capacity for productive work and satisfying and loving relationships. However, those who remain fixated at previous stages will suffer from underdeveloped personalities, which cause any number of problems in their subsequent adulthoods.

Modern psychodynamic psychologists generally agree that Freud's stages of psychosexual development are not an accurate view of personality development. However, even this is not entirely clear; clinical psychologists often report observing patterns that are consistent with Freud's observations of each stage of psychosexual development (Westen, 1998). For example, one study reported that young children are more likely to show affection to the same-sexed parent and aggression toward the opposite-sexed parent (Watson & Getz, 1990). This is reminiscent of the Oedipus complex, although the underlying mechanisms are not necessarily the same (i.e., notice there is no reference to sexual attraction or murderous intent).

A huge challenge faced (and never surmounted) by Freudian thinkers was how to empirically measure many of the concepts and processes described in Freud's theories. For example, how exactly does one measure the contents of the unconscious? How can we measure something that, by definition, people are unaware of?

Exploring the Unconscious with Projective Tests

Listen to the Audio

As discussed earlier in this module, Freud devised a number of techniques for peering into the inner workings of the unconscious, such as analyzing the "psychopathologies of everyday life" for evidence of defence mechanisms and hidden motivations. Freud also refined methods, such as dream analysis and free association, which were believed to reveal unconscious material by side-stepping the conscious mind. For example, dream analysis was based on the belief that the material in the unconscious, although not accessible to the conscious mind, nevertheless was depicted in our dreams. However, because much of the unconscious operates without language, dreams would not be literal, but symbolic representations of the contents of the unconscious. Thus, the dream analyst had to learn to properly interpret the symbolic meaning of dreams in order to understand what could be learned from the unconscious.

Since Freud's time, psychodynamic psychologists have attempted to develop more standardized techniques for probing the unconscious. One popular approach is to use **projective tests**, *personality tests in which ambiguous images are presented to an individual to elicit responses that reflect unconscious desires or conflicts*. They are called "projective" because the image can be interpreted in different ways, and the particular interpretation a person chooses is thought to be a projection of her unconscious.

One of the most familiar projective tests is the **Rorschach inkblot test**, *in which people are asked to describe what they see in an inkblot, and psychologists interpret this description using a standardized scoring and interpretation method* (Exner, 1991; see Figure 12.7). Another projective test is the **Thematic Apperception Test (TAT)**, *which asks respondents to tell stories about ambiguous pictures involving various interpersonal situations* (Figure 12.8). For example, a picture might show a man and woman looking at each other with blank expressions. Subjects are asked to tell a story about the picture. Who are these people? What emotions are they feeling? Why are they looking at each other that way? The details in the story that a person makes up are thought to be a projection of their personality functioning, and thus, a way of illuminating their unconscious.

Figure 12.7 The Rorschach Inkblot Test

Some psychologists attempt to measure personality characteristics by analyzing the verbal responses clients use to describe what they see in an inkblot such as this (which clearly shows an image of your parents).

Equinox Imagery/Alamy Stock Photo

Figure 12.8 The Thematic Apperception Test

In this projective test, the individual is asked to tell a story about what is happening in the image. The responses to this task are believed by some to give important insights into an individual's personality.

Ken Karp/Pearson Education

Unfortunately for proponents of projective tests, they have not fared well in empirical research, receiving criticism for low reliability and validity. Low reliability indicates that the test will not give the same measurement on subsequent assessments of the same person. Low validity indicates that the test does not actually measure what it purports to measure. For example, although projective tests are supposed to measure personality functioning, in some cases, such as the figure-drawing test shown in Figure 12.9, they actually measure a combination of artistic ability and intelligence (see Lilienfeld et al., 2000). Time and again, research has indicated serious limitations regarding the reliability and validity of projective tests (Garb et al., 2005; Lilienfeld et al., 2000).

Figure 12.9 Figure Drawing as a Projective Test

Figure drawing is another projective technique used by many psychologists. The content of the drawings is analyzed and interpreted by the therapist. It turns out that these drawings are somewhat related to artistic ability and intelligence, but not personality (Lilienfeld et al., 2000).

S. O. Lilienfeld, J.M Wood, & Howard N. (2000). Garb Psychological Science in the Public Interest, 1(2), 27-66.

Despite criticisms from some researchers, many therapists claim that they have experienced significant breakthroughs by using projective tests. A survey in the mid-1990s estimated that 43% of clinical psychologists and psychiatrists made frequent use of projective tests (Watkins et al., 1995). More recently, a survey of school psychologists showed that the TAT and Rorschach were used by 30% and 14% of these professionals, respectively, although their popularity appears to be declining (Hojnoski et al., 2006).

Working the Scientific Literacy Model

Perceiving Others as a Projective Test

Listen to the Audio

There are clearly problems with the reliability and validity of some projective tests, but the basic idea of projection remains compelling to many psychologists. Could there be some way to measure projection with greater accuracy? One promising direction is to look at how people make judgments about what other people are like.

What do we know about the way people perceive others?

People have a seemingly natural inclination to make assumptions about what others are like, even if only very limited information is available. We may judge people we hardly know as friendly, aggressive, selfish, or trustworthy, for example. But with virtually no information to guide us, how do we make these judgments? One possibility is that we make guesses as to what other people are like by using our own self-concepts as a guide. With no other information to go on, we tend to assume that most people are kind-of like us. The trait of Machiavellianism (see Module 12.1) provides a great example. People who exhibit this trait are generally willing and able to manipulate and deceive others to get what they want. Interestingly, they are more likely than the the general population to see others as being cynical and selfish

(Christie & Geis, 1970). Thus, psychologists suggest that the degree to which an individual sees people as selfish and cynical is, to an extent, a projection of his own Machiavellianism (Wood et al., 2010).

How can scientists study how projection relates to personality?

Although projection was initially a psychodynamic idea, contemporary researchers have begun to apply it to other approaches, such as the trait approach. In one study, participants rated both themselves and others in terms of personality traits such as the Big Five, narcissism (i.e., excessive self-importance), and symptoms of depression. Researchers found that the way that participants viewed themselves was related to how they viewed others. For example, people who viewed themselves positively (as agreeable, intelligent, and satisfied with life) were likely to view others the same way (Wood et al., 2010). This provided evidence that how people perceive others appears to be a projection of how they perceive themselves.

Can we critically evaluate this research?

The results of this study indicate that self-ratings and ratings of others are correlated. However, the correlations themselves are not very large, meaning that psychologists cannot make *precise* predictions about a rater's personality based on that individual's ratings of others, but rather can make only *general* statements. Furthermore, this study does not provide evidence that projection is actually occurring (i.e., that people are actually using their own self-concepts to guide their impressions of others). It could be the case that people are simply positive or negative in general, such as being optimistic or pessimistic. Positive, optimistic people would tend to see themselves and others positively, and negative, pessimistic people would do the opposite. Thus, the correlation

between ratings of self and other simply reflects a general disposition, not a specific process of projection.

Why is this relevant?

Standard projective tests such as the Rorschach inkblot test and the Thematic Apperception Test are fraught with problems and controversy. It would be unheard of for modern medical doctors to diagnose disorders using procedures that are as unreliable and of as questionable validity as these tests. Thus it is important to search for new and better methods that might reveal meaningful information about the individuals taking them. Psychology need not necessarily abandon projective tests altogether, as the benefits of adding rigour and scrutiny to them has shown that they can be of value (e.g., Schultheiss & Brunstein, 2001).

Alternatives to the Psychodynamic Approach

Listen to the Audio

Freud attracted many followers, but some of his contemporaries took psychodynamic psychology in different directions. They recognized that sex and aggression are not the only motives driving personality development. Indeed, other motivational forces, such as the need for belonging, the need for achievement, and the need for integrity or wholeness, are important aspects of personality.

Analytical Psychology

Listen to the Audio

Carl Jung (1875–1961) made a dramatic break from Freud over disagreements about a number of issues, founding the analytical psychology movement. **Analytical psychology** *focuses on the role of unconscious archetypes in personality development*. The archetypes were believed to be housed in a region of the unconscious unique to Jung's theories. In contrast to the Freudian unconscious, Jung believed that there were two main types of the unconscious: a **personal unconscious**, which was basically the same as the Freudian unconscious, *a vast repository of experiences and patterns absorbed during the person's life*; and a collective unconscious, which is not held within the individual person. The **collective unconscious** is *a separate, non-personal realm of the unconscious that holds the collective memories and mythologies of humankind, stretching deep into our ancestral past*. Jung thought of the personal and collective unconscious as entirely different "levels" of consciousness, although they are so different from one another as to be basically completely different things. The personal unconscious is still housed within the person, but the collective unconscious is more like a larger field of forces, which shape the individual personality in certain characteristic ways.

Within analytical psychology, archetypes played a central role; **archetypes** *are images and symbols that reflect common patterns of experience across all cultures*. There are many different archetypes and several particularly important ones, including the Mother, the Child, the

Trickster, the Wise Old Man, the Hero, and the Shadow, among others. The Shadow archetype represents unwanted aspects of the self that the person is unwilling to acknowledge. This archetype has been particularly influential among psychologists who emphasize personal growth, individual empowerment, and healing from trauma (e.g., Ford, 2002). These archetypes were thought to represent major narrative patterns in human experience, part of the universal tapestry of human life. Thus, when archetypal symbols appeared (e.g., in a person's dreams), it was believed that they could be interpreted and would give important insights into the person's personal growth and well-being. Archetypes are a very popular aspect of Jungian psychology, but they have not had much of an impact on the rest of the field, again due to their unscientific nature.

The Power of Social Factors

Listen to the Audio

Alfred Adler (1870–1937) initially differentiated himself from Freud by arguing for the importance of social dynamics and conscious thoughts (as opposed to sexual and aggressive drives in the unconscious) as determinants of behaviour. He rejected the centrality of the pleasure principle, instead emphasizing the **inferiority complex**, *the struggle many people have with feelings of inferiority, which stem from experiences of helplessness and powerlessness during childhood*. Adler described how people strive to compensate for their feelings of inferiority by trying to appear competent and, in many cases, overcompensate for inferior feelings by trying to be or appear superior to others. Adler's theories of the importance of the need for power have had a profound influence on the field of psychology and continue to inspire contemporary research (e.g., Watts, 2000).

Karen Horney (1885–1952) also disagreed with Freud's heavy emphasis on sex, and especially infantile sexuality. Instead, Horney (disappointingly pronounced "HORN-eye") focused on the importance of social and cultural factors, arguing that to understand personality one should focus on the functioning of a person's present self, rather than overwhelmingly focusing on the unconscious, which was largely formed in early childhood. Horney highlighted the role of interpersonal conflict between children and their parents as important to personality development. She also strongly advocated against Freud's "phallocentrism" (i.e., emphasis on the penis). To counter his theory of

the Oedipus complex, Horney argued instead that men suffer from "womb envy," because men can never experience the miracle of birth and of carrying another human life as part of oneself, or the experiences of breastfeeding and other biological acts of motherhood. She said that men attempted to compensate for their perceived deficiencies by focusing on work and by devaluing and subjugating women. While Freud believed that women suffered from penis envy, Horney argued that any "envy" Freud observed in the female psyche was envy of the patriarchal power enjoyed by men, not of men's sexual equipment (Paris, 1994).

As you can see, psychodynamic theorists have separated themselves in a number of important ways. Contemporary psychodynamic psychologists work mostly in the field of clinical and counselling psychology. And, despite some differences, modern psychodynamic psychologists do share many of the core attributes of psychoanalytic thought: an emphasis on the unconscious, internal conflicts between opposing forces within personality, and the influence of early experiences on adult personality (Westen, 1998).

Humanistic Perspectives

Listen to the Audio

Reacting against the pessimism and disempowerment inherent in Freudian approaches, the humanistic psychologists wanted to explore the potential for humans to become truly free and deeply fulfilled. Thinking outside the boxes of behaviourism and psychodynamic theories, the humanistic psychologists emphasized the individual's free will to make choices, highlighted positive motivations for personal growth and development, and explored the upper ranges of human experience, such as feelings of transcendence, love, and fulfillment. Proponents of the humanistic approach believed it would become the "third force" in psychology, after psychoanalysis and behaviourism.

Among the many influential humanistic psychologists, Carl Rogers was perhaps uniquely responsible for helping to launch the movement and for cementing certain ideas in the field that remain to this day. Rather than the Freudian depiction of people plagued by complexes and defences, Rogers championed a **person-centred perspective**, founded on the assumption that *people are basically good, and given the right environment their personality will develop fully and normally*. Rogers believed that people possess immense inner resources for growth and resilience, and a desire for **self-actualization**, which is *the drive to grow and fulfill your potential*.

According to Rogers, fully functioning, self-actualized people deeply accept themselves and are highly self-aware. Having moved beyond the need to erect defences to ward off negative feelings, they become aware

of their inherent goodness. Rogers believed that the more self-actualized a person becomes, the more their inherently good nature will dominate his personality. Other leading humanistic psychologists, such as Abraham Maslow, also sought to identify the characteristics of fully functioning, self-actualizing people. Research on human strengths and virtues continues to this day, gaining new life in recent years through the positive psychology movement, with renewed interest in topics like personal growth, gratitude, authenticity, and meaning.

Review Applying Psychodynamic and Humanistic Views of Personality

Study the table, then select "Check Your Understanding" to test your knowledge.

Psychodynamic	Humanistic
"Interactions between our primal drives and our attempts to control them are judged by an inner voice resembling that of our parents."	"One barrier to developing a complete and mature personality is a negative self-concept. A belief that we cannot change or improve."
"Failure to resolve intrapsychic conflicts during early development will have lingering negative effects on adult personality."	"People are inherently good, and are not controlled by deviant or instinctive urges."

Check Your Understanding

Module 12.3 Summary

Listen to the Audio

12.3a Know . . . the key terminology related to the psychodynamic and humanistic approaches to personality.

Review Module 12.3

Start Over Swap

0/17 REVIEWED · 0 MASTERED

collective unconscious

Previous Next Got It!

12.3b Understand . . . how people use defence mechanisms to cope with conflicting thoughts and feelings.

According to the psychodynamic perspective, defence mechanisms activate whenever we are threatened by feelings of anxiety due to

conflicts between different systems within consciousness. These mechanisms include denying and repressing urges, displacing them, or finding more acceptable ways of expressing them.

12.3c Understand . . . the developmental stages Freud used to explain the origins of personality.

To explain personality development, Freud began with the concept of libido—the id's energy source for the drives that originate at different focal points of the body from infancy to adolescence. Each of the stages of psychosexual development—oral, anal, phallic, latent, and genital—is associated with a unique form of conflict as the ego and superego develop. Failure to resolve the corresponding conflict can result in a fixation, in which the person is stuck at a certain phase of development, and this can cause problems later in life.

Review Stages of Psychosexual Development According to Freud

	Age	Pleasure Focus	Fixations Result in . . .
Oral	0-18 months	Sucking, chewing, swallowing	Overeating, smoking, biting nails
Anal	18-36 months	Bowel elimination, self-control	Excessively clean or sloppy
Phallic	3-6 years	Genitals	Castration anxiety or penis envy
Latency	6 years-puberty	Sexual interest dormant	None
Genital	Puberty and after	Sexual experiences with others	None

Check Your Understanding

12.3d Apply . . . both psychodynamic and humanistic perspectives to explain personality.

Apply Activity

To apply the psychodynamic approach to understand someone's personality, you would consider the role that unconscious processes play in determining behaviour, as well as the conflicts that exist between a person's impulses and his need to regulate them. Review Freud's structure of the mind (illustrated in Figure 12.6) and the psychosexual stages of development. What might each of the following situations mean from Freud's perspective?

1. A student cannot concentrate on their homework until every little item on the desk is in its appropriate place.
2. An individual commits violent acts against others without feeling any remorse.

To apply the humanistic perspective to understand personality, you would look at the person's motivations for personal growth and fulfillment and consider whether they embody the set of traits described by Maslow as characterizing self-actualized people. In each of the following scenarios, which personality characteristic could the person work on changing in order to move toward becoming self-actualized?

1. Dave is a pragmatic guy, preferring the hard, cold facts of reality to fantasies about how life could be different. He is not afraid to express what he really thinks, and is not very concerned about whether other people accept or reject him. Because he is so comfortable with himself, he has little anxiety and can behave spontaneously and freely in most situations. He feels strongly patriotic toward his country, and thinks that government should

focus on issues like taxes and the economy, rather than trying to help people who are disadvantaged due to poverty.

2. Zoe is enthusiastic about life and has a strong spiritual practice, using meditation and prayer to feel closer to the divine. She feels profound empathy for people in all parts of the world and is described by her family as a "bleeding heart," someone who cares strongly for people who are worse off than her. She regrets some of the choices she made earlier in life, and although she tries to learn from them, finds herself often nostalgically thinking about the past. She has many friends and is very socially active, in part because she is such a people-pleaser that she is good at presenting herself in such a way that she makes other people comfortable.

12.3e Analyze . . . whether projective tests are valid measures of personality.

In this module you learned about projective tests such as the Rorschach inkblot test and the Thematic Apperception Test, which some psychologists believe are useful tools that give them insight into unconscious processes. However, projective tests do not appear to be valid ways of assessing characteristics of a person's personality.

12.3f Analyze . . . the strengths and weaknesses of psychodynamic perspectives.

Psychodynamic theories can provide some compelling explanations for human motivation. For example, it is easy to understand how social and moral conflicts arise when couched in terms of a struggle between the id and the ego. At the same time, this approach does not have a lot of scientific support. Its key concepts, such as the id, ego, and superego, are theoretical constructs that cannot be empirically measured. Also, the

psychosexual stages of development are no longer believed to be accurate descriptions of stages that children go through while growing up.

Chapter 13
Social Psychology

Listen to the Audio

13.1 The Power of the Situation: Social Influences on Behaviour
- Situational Influence on Behaviour: Mimicry, Norms, and Roles
- Group Dynamics
- To Act or Not to Act: Obedience, the Bystander Effect, and Altruism
- Working the Scientific Literacy Model: The Bystander Effect
- Module 13.1 Summary

13.2 Social Cognition
- Person Perception
- The Self in the Social World
- Stereotypes, Prejudice, and Discrimination
- Working the Scientific Literacy Model: Explicit versus Implicit Measures of Prejudice
- Module 13.2 Summary

13.3 Attitudes, Behaviour, and Effective Communication
- Changing People's Behaviour
- Using the Central Route Effectively

Working the Scientific Literacy Model: The Identifiable Victim Effect

Using the Peripheral Route Effectively

The Attitude–Behaviour Feedback Loop

Module 13.3 Summary

Module 13.1 The Power of the Situation: Social Influences on Behaviour

Listen to the Audio

Sundry Photography/Shutterstock.

Learning Objectives

13.1a Know . . . the key terminology associated with social influence.

13.1b Understand . . . why individuals conform to others' behaviours.

13.1c Understand . . . how individuals and groups can influence behaviours.

13.1d Apply . . . your knowledge of being a passive bystander or active altruist to understand your own likeliness to help.

13.1e Analyze . . . whether people who harm others are fundamentally hurtful, mean people or if their behaviour is the product of social influences.

In 2006, Tarana Burke started the Me Too movement with the goal of empowering survivors of sexual violence. Over the next decade, Me Too was able to improve the lives of many people by de-stigmatizing what it means to be a survivor and encouraging society to hold the perpetrators responsible. Throughout Canada and the United States there was now increasing public awareness of sexual violence, though nothing can match the power of what happened in 2017 when a number of allegations of sexual assault, many against internationally known, high-powered figures from the news media and entertainment industry, led to charges against the film producer Harvey Weinstein. These accusations against one of the most influential people in the film industry unleashed the full power of the Me Too Movement. On October 15, 2017, actor Alyssa Milano took to social media asking individuals to acknowledge their experience of sexual violence with a #MeToo hashtag. Her intention was to give the public a sense of the magnitude of the problem (Levenson & Guerra, 2017). By the end of the next day, #MeToo had appeared on Twitter over 500 000 times (The

Economist, 2018). In the following 12 months, #MeToo had been tweeted over 19 million times (Pew Research Center, 2018). As of 2019, the movement is still going strong.

From a psychological perspective, a movement such as #MeToo reveals something fascinating about human behaviour. Millions had been living with secrets while having daily interactions with others who shared the same, painful experiences. Social pressure can exert an amazing power to suppress behaviours—it seemed better to so many people to swallow their emotions rather than to share them. Yet social pressure can do the opposite as well. Once a handful of people started to open up, others became more willing to share; once they shared, it empowered even more people to come forward. This isn't a one-time event either. #MeToo regularly surges back into the twitterverse anytime there is a major news story about sexual violence (Pew Research Center, 2018).

To psychologists, understanding social influences on behaviour is very important because at its worst, it can create enormous amounts of suffering. But at its best, it has the power to improve lives.

We tend to feel that we are in charge of our own behaviour—that we are free to determine what we do and what we choose not to do, and that we act for good reasons, not just to go along with the crowd. Social psychology challenges these ideas with strong evidence that much of our behaviour depends more on *where* we are than on *who* we are.

Kurt Lewin, one of the first social psychologists, conceptualized psychology by a simple equation—$B = f(P,E)$—symbolizing that *Behaviour* is a function of the *Person* and the *Environment* (1936). This insight challenged the Freudian theories of the early 20th century, which focused solely on the person and their unconscious drives. Lewin's formula also challenged behaviourism, which focused solely on the environment.

Lewin, therefore, did what is so often the most reasonable thing to do: take all things in moderation. In doing so, he emphasized the role of the individual in choosing what situations to go into, how to interpret a situation, and, ultimately, how to respond. The past 80 years or so of research in social psychology that has flowed from this insight has pieced together a deep understanding of the situational forces and individual characteristics that determine human behaviour.

Situational Influence on Behaviour: Mimicry, Norms, and Roles

Listen to the Audio

To begin our study of social psychology, we must first acknowledge that humans are fundamentally social creatures; perhaps the biggest part of the "E" is the *social* environment. Even the biggest introverts among us are remarkably sensitive to what is socially acceptable or unacceptable. This doesn't limit itself to the difference between right and wrong—it can be something as simple as how to walk down the street. Is it appropriate to make eye contact with strangers and give them a warm greeting? In some situations, it would be incredibly rude not to. In others, it could lead to an awkward interaction or even get you beaten up. Of course, we don't always get it right and some people are better than others at making these social judgments, but the vast majority of people in the most situations somehow seem to know how to behave. In this section, we will find out why.

Synchrony and Mimicry

Listen to the Audio

Exactly how do social influences become incorporated into our thoughts and behaviour? Neuroscientists and psychologists have observed that humans often become synchronized, in a sense. Synchrony occurs when two individuals engage in social interactions, and their speech, language, and even physiological activity become more alike (Gordon et al., 2019). Similarly, humans often engage in **mimicry**, *taking on for ourselves the behaviours, emotional displays, and facial expressions of others*. Perhaps you have caught yourself inadvertently copying another's behaviour. But most of the time it is a completely unconscious activity. You tend to laugh and smile when others are laughing and smiling. More generally, you display the same emotional expressions on your face as those you see on the faces around you, and then pick up their moods as well. And if someone else is whispering, you will likely whisper, even if it is to ask, "Why are we whispering?" The examples are literally endless; practically every moment of social interaction between people involves mimicry.

This kind of subtly attuned mimicry is highly functional (Lakin et al., 2003; Tschacher et al., 2014), serving as a "social glue" and helping to coordinate behaviours in social settings. Mimicry helps people feel reassured and validated by each other, sending the unconsciously processed message to others that you are kind of like them, and more so, that you are paying attention to them in that moment. However, it's a different story if you try to *intentionally* mimic people's behaviour in order to manipulate them. Consciously trying to "steer" this process could lead

you into trouble, just like focusing too much on a well-practised movement can cause you to mess it up. Indeed, if someone notices that a person is mimicking them, they like that person less as a result (Maddux et al., 2008); so, if you are using this power for your own nefarious purposes, at the very least, be subtle about it!

Norms and Roles

Listen to the Audio

Social norms *are the (usually unwritten) guidelines for how to behave in social contexts*. Some of the more readily observable norms are those associated with age, gender, and socio-economic class, and you can see them influence everything from our manners (e.g., you probably make different jokes when out with your friends than when you meet your boy- or girlfriend's parents for the first time) to the clothes we wear (e.g., you shouldn't show up to the typical funeral wearing cargo shorts and a sleeveless T-shirt).

Norms are mostly implicit and emerge naturally in social interactions, although there are plenty of examples to the contrary. When you were a child, adults most likely told you specifically how you were expected to behave in different situations. As an employee, your supervisor may have provided you with verbal instructions or a policy manual about what is expected for manners, dress, and so on. Despite these examples, we adapt to new norms all the time without even realizing it. In fact, people often fail to realize this and instead believe that their behaviour is freely chosen (Nolan et al., 2008).

Our tendency for mimicry helps us figure out normative behaviour, but what motivates us to go along with norms? One very important motivator is social approval. Individuals who don't appear "normal" (meaning some aspect of their behaviour challenges the norm) are often subject to all kinds of unpleasantness, ranging from insults to legal trouble.

Ostracism, *being ignored or excluded from social contact*, is another powerful form of social pressure (Hartgerink et al., 2015; Pfundmair & Wetherall, 2018). Imagine this scenario: You arrive in the Psychology Department to participate in a study. In the waiting area, another student spots a ball in a basket of toys, picks it up, and gives it a playful toss to you. A third student in the room holds up his hands, so you toss him the ball. This isn't a fun game but it does pass the time. But what happens if the other two students for no apparent reason and without any provocation begin to only toss the ball back and forth with each other? This is an experimental method to produce ostracism developed over a 20-year period by Kip Williams and his graduate students (Williams & Nida, 2011). Although being left out of the game may sound trivial, the effects are anything but. The most noticeable observations across dozens of studies include anger and sadness; these effects have held up across many variations in the ball-toss procedure. Other typical responses include temporarily lowered self-esteem, self-confidence, and even a reduced sense of a meaningful existence.

With all of these negative effects, you can see how ostracism could encourage someone to go along with the norms. In fact, ostracism can lead to hyper-normative behaviour. For example, individuals who experience a high *need to belong*—a type of personality trait—have a strong response to ostracism. In one study on morals, for example, high need-to-belong participants responded to ostracism by (1) increasing how much they identified with their in-group's beliefs (such as a political group, church, social organization, etc.) and (2) increasing how morally important those beliefs are (Pfundmair & Wetherell, 2018). At its worse, ostracism can produce aggression in laboratory studies, and this has led researchers to note that, at the time of their writing, 13 of the 15 most recent school shooting perpetrators had experienced significant ostracism (Williams & Nida, 2011).

#Psych

From Cyberball to Ghosts

As you have read, ostracism can be studied in the laboratory with success; however, the majority of the research in the past 15 years has been online in the form of Cyberall, a video game version of the ball-tossing experiment. One recent meta-analysis combined the results of 120 studies that included a total of over 11 000 participants (Hartegerink et al., 2015). This provided solid evidence that social exclusion can have a very big effect on an individual, even when online, even when interacting with strangers, and even when engaged in a game that is, at best, a little bit dull. Alternative software programs have simulated ostracism in chat rooms (Donate et al., 2017) and social media (Wolf et al., 2015), finding very similar results. Outside of psychological research, *cyberostracism* has been observed in a variety of ways and with similar effects. Sometimes these effects are minimal, such as when someone keeps checking a tweet or post yet still has not received responses (Mai et al., 2015; Tobin et al., 2014). Cyberostracism can become extreme, however. That is true for *ghosting,* in which one person completely excludes another from any form of electronic contact and without any explanation, usually in order to end a personal relationship. Although ghosting is too new to have been the subject of much research, what we know about ostracism should give us an indication of how ghosting might feel (Freeman et al., 2018).

While norms are general rules that apply to members of a group, **social roles** *are guidelines that apply to specific positions within the group*. Because

roles are so specific, we often have labels for them such as professor, student, coach, parent, and even prison guard. This latter role happens to be one of the most famous roles in psychology. The Stanford Prison Experiment of the early 1970s has become a memorable and controversial narrative of how quickly people might adapt to assigned roles—it has even been made into a feature film by that name (*The Stanford Prison Experiment* [Motion Picture], 2015) and inspired one other. What makes this study so memorable?

In 1971, researchers at Stanford University recruited a group of young men and randomly assigned them to play the part of prisoner or guard in a makeshift jail in the basement of the psychology building. The lead investigator, Phillip Zimbardo, coached the guards on how to play the role, even relying on consultation from a former prisoner on how to best mimic actual prison guard behaviours he experienced while incarcerated. Unsurprisingly, some guards became quite hostile and abusive, and in response many of the "prisoners" became helpless and submissive (Haney et al., 1973). The study was terminated before the planned two-week period. The reason offered by Zimbardo at the time was that the situation had gotten out of hand—the role-playing exercise became its own reality and the prisoners were starting to show extreme duress. (However, this has been refuted multiple times by one of the prisoners in a 2004 interview; Toppo, 2018). Whether you accept Zimbardo's worst-case-scenario explanation, or the more moderate one offered by some participants, the point is still very important: People placed into situations change their behaviour. Sometimes the change is intentional, but often it is not a conscious act. Sometimes the change is minor, but the situation can also demand enormous changes.

Classic studies have always been an essential part of learning about social psychology—they are often fascinating and illustrate concepts very well. It is also important to separate interesting story and narrative from scientific

reality. Recall the concept of *demand characteristics* covered in Module 2.1: Providing the guards with specific instructions on how to play their role weakens Zimbardo's conclusion that the power of these randomly assigned roles turned otherwise good people into cruel guards and desperate victims (see Banuazizi & Movahedi, 1975). Interestingly, in the early 2000s a similar study, the British Prison Study, controlled for demand characteristics and found that the guards were actually very reluctant to engage in abusive behaviour, and the prisoners eventually coalesced to agree upon strategies with how to deal with being locked up together, and thereby improved their well-being over the course of the study (Haslam & Richer, 2012). Thus, the power of the situation can bring people together to play the role of "survivor."

Prison studies aside, the importance of norms can be illustrated in many other ways. For example, alcohol abuse among university students is an increasing problem in Canada and the United States, and psychologists have found that perceived norms are likely to be a factor. Students who perceive norms to be high tend to overestimate rates of drinking on campus and are much more likely to be binge drinkers and heavy drinkers themselves (Foster et al., 2015; Wardell & Read, 2013). We should keep in mind that this is correlational research, so we cannot establish whether the norms lead to more drinking or vice-versa, but research suggests that interventions aimed at correcting misperceptions of the norm can lead to decreased alcohol abuse (LaBrie et al., 2013; Ridout & Campbell, 2014). We should also keep in mind that alcohol use is just one example of the power of norms. In fact, our perceptions of what is normal are likely to influence everything we do. And, as you'll see in the next section on group dynamics, perceptions about what is normal can be formed and exert influence on people almost instantly.

Group Dynamics

Listen to the Audio

Mimicry, roles, and social norms highlight the fact that much of our lives are spent in groups, whether it's hanging out with friends, collaborating on school projects, or navigating a crowded sidewalk. A key question in social psychology is whether the subtleties of mimicry and norms lead us to behave differently in groups than we would alone, and how the behaviour of individuals may differ from the behaviour of a group.

Social Loafing and Social Facilitation

Listen to the Audio

Let's start with a question about your own experiences in groups—how do you feel about group assignments? Do you like them because they're an opportunity to get to know people, or maybe because your previous experiences show that groups can accomplish something more impressive together than you could alone? Or do you hate group projects because other people waste so much time or because people don't have very good ideas or because some people are slackers whose work doesn't meet your standards and you end up having to do everything yourself? Research at various types of higher education settings finds that students' opinions are divided, but many of those feelings are quite strong (e.g., Chang & Brickman, 2018; Gottschall & Garcia-Bayonas, 2008) Regardless of your feelings, you are almost certainly going to be working in groups in the future. Whether it's your job, family and community groups, or the group project your professor assigns to your class, it's pretty tough to avoid working with other people.

Often one of the main purposes of a group is to work on more complex and sophisticated projects than an individual could by working alone. But does this really happen? Do groups produce better work, making the most out of individuals' ideas and encouraging their best efforts? Or do they produce poorer outcomes, limiting people's creativity and enabling them to slack off? Oddly enough, the answer to both questions is "yes, sometimes."

Groups sometimes produce poorer outcomes due to **social loafing**, *which occurs when an individual puts less effort into working on a task with others*. There are various phrases for describing this—*coasting, slacking, free-riding*. Social loafing can occur in all sorts of tasks, including physical activities (e.g., swimming, rope-pulling), cognitive activities (e.g., problem solving, perceptual tests), and creativity (e.g., song writing), and across all types of groups, regardless of age, gender, or nationality (Karau & Williams, 2001; Latané et al., 2006). One reason why people loaf is because they think others in the group are also not doing their best, setting up an apparent social norm that "people in this group don't work very hard." There are two likely outcomes of social loafing. Either the group performs quite poorly (i.e., crashes and burns), or a small number of people end up saving the group by doing everything themselves. Given the importance and inevitability of group work, it is important to understand what factors encourage loafing, so we can avoid them (Hall & Buzwell, 2013).

- **Low efficacy beliefs**. This occurs if tasks are too difficult or complex, so people don't know where to start. Structure tasks so people know exactly what to do, provide clear deadlines, and give people feedback so they know how well they are doing and how they can improve.
- **Believing that an individual's contributions are not important to the group**. This occurs if people can't see how their own input matters to the group. Overcome this by helping people understand how group members rely on and affect each other, and assigning tasks to people that they feel are significant or they've had some say in choosing (if possible).
- **Not caring about the group's outcome**. This occurs when a person is not personally identified with the group, perhaps feeling socially rejected from the group or perceiving the group as unsuccessful or unimportant. Overcome this by making the group's goals and values

clear and explicit, encouraging friendships to form and group activities to be fun and socially rewarding.

- **Feeling like others are not trying very hard**. As discussed earlier, people loaf if they feel others are loafing (Karau & Williams, 2001). Overcome this by providing feedback about the progress of group members on their individual tasks; strong groups often have regular meetings where people's progress is discussed and, ideally, celebrated!

In contrast to social loafing, **social facilitation** *occurs when one's performance is affected by the presence of others* (Belletier et al., 2019). For example, in perhaps the first social psychology experiment ever published, Norman Triplett (1898) found that cyclists ride faster when racing against each other than when trying to beat the clock. Many other researchers have found similar effects, even in animals. For example, ants are able to dig more when other ants are working alongside them (Chen, 1937), and even cockroaches run down a runway more quickly when other cockroaches are around (Zajonc et al., 1969).

The presence of others doesn't always improve performance, however. We're all familiar with the athlete who "choked" at the big moment. The presence of others is likely to interfere with our performance when our skills are poor or the task is difficult. Even the cockroaches mentioned earlier did more poorly when other cockroaches watched them try to navigate a more complex maze (Zajonc et al., 1969).

There are many mechanisms that explain the social facilitation effect (Uziel, 2007; Belletier et al., 2019). One of the most important is that the presence of others is (emotionally) arousing, and arousal tends to strengthen our dominant responses. Similarly, the presence of others occupies our attention, reducing our ability to consciously direct out behaviour. For both reasons, when the task is simple (e.g., run in a

straight line), our dominant responses are the right ones. But when the task is very complex (e.g., juggle three axes for the first time), we need to be able to pay more attention and control our responses more carefully, and then arousal decreases performance. Based on these tendencies, it is probably not surprising that, for true masters of a skill, audiences and competitors generally enhance performance, but novices tend to perform best in practice sessions when nobody's watching (Bell & Yee, 1989; MacCracken & Stadulis, 1985).

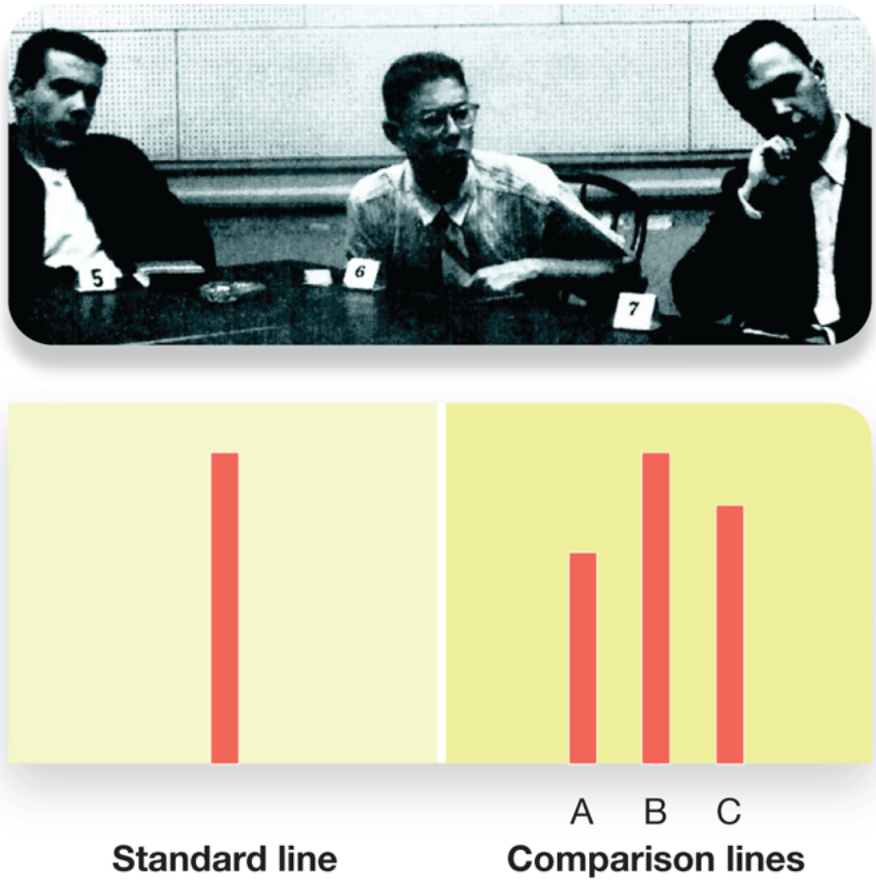
Conformity

Listen to the Audio

At the most basic level, conformity can be found in mimicry, and it can be a very useful skill at times. Imagine travelling to a country where you do not know the language and no one is around to help you translate. Could you get by? If you want to ride public transportation, just watch what the other passengers are doing. Do they buy tickets before boarding, or do they pay a driver once they board? Following another's lead is often the best way to go, even if you are just walking into a new restaurant in your neighbourhood.

The study of mimicry focuses on how we are influenced by a single individual, but being part of a group can affect our behaviours as well. Conformity refers to a change in behaviour to fit in with a group, whether it is intentional or not. In the 1950s Solomon Asch developed a very creative way to study conformity in the lab and conducted a series of studies that are nearly as famous as the Stanford Prison Experiment. In this method, a research participant would join a group of subjects in a room and complete a series of very simple and obvious perceptual judgments—judgments that anyone should get right (see Figure 13.1). However, the other "participants" in the room were actually *research confederates*, meaning that Asch had placed them there with instructions to give the wrong answer at specific times. Despite the simplicity of the task, the participants would often conform to the rest of the group and give an incorrect answer (Asch, 1951, 1955, 1956).

Figure 13.1 Perceptual Judgment Task in Asch's Conformity Studies



Which of the comparison lines is the same length as the standard line? In Asch's experiments, many people conformed to the confederates and gave the wrong answer.

Why we sometimes conform so readily is an important psychological question. There are two pretty clear reasons and they lead to different types of conformity. First, **normative influence** *is the result of social pressure to adopt a group's perspective in order to be accepted, rather than rejected, by the group*. This is sometimes referred to as *public compliance* because the individual modifies what they say or do without internalizing their conformity—it is a public rather than private type of conformity (Cialdini & Goldstein, 2004). This generally means that the person

sacrifices a little honesty about their own beliefs in order to avoid criticism or rejection from the group. Second, **informational influence** *occurs when people feel the group is giving them useful information*. This can be referred to as *private acceptance*, when people actually change their internalized beliefs and opinions as well as their public behaviour. In this situation, the conforming individual is likely to see other group members as being better informed, having more skill, or perhaps better taste; thus they are a good source of information.

The following experiment demonstrates that the two types of conformity may work together: A group of young heterosexual men participated in a study of facial attractiveness by rating photographs of females on a scale from 1 to 10. Then they received randomly assigned feedback indicating that the average rating for that same face was higher, lower, or the same than they gave. In subsequent trials, many of the participants changed their ratings to conform to the perceived group norm. Perhaps they wanted to make sure they were doing a good job and using the same standards as others (normative compliance). However, they changed their behaviour even though their responses were not being observed. It would appear that this represents private compliance—perhaps perceptions of attractiveness really are influenced by what others think (Huang et al., 2014).

Both types of influence seemed to be occurring in Asch's studies as well. For example, some of the conforming participants said afterwards that they thought they had misunderstood something, or that there was some sort of "trick" the others picked up on that they didn't, because surely the others couldn't all be wrong if they were all saying the same thing. Other people reported that they didn't want to stand out or make a scene by being the disagreeable person, so they just went along with the group. In everyday contexts, both types of influence are often at work, making us easily swayed by other people. We will be especially vulnerable to social

influence when we are uncertain about the situation, although as Asch showed us, social influence is powerful enough to make us doubt ourselves even when the situation is pretty clear and unambiguous. Many factors work together to determine, in a given situation, the strength of social influence pressures and whether or not a person ends up conforming (see Table 13.1).

Table 13.1 Personal and Situational Factors Contribute to Conformity

Table 13.1 Personal and Situational Factors Contribute to Conformity

People Tend to Be Less Likely to Conform When . . .	People Tend to Be More Likely to Conform When . . .
Only one other person is in the vicinity	There is a larger group in the vicinity
There are only strangers in the room	There are friends, family, or acquaintances in the vicinity
There are extremely clear and simple tasks	The task is unclear or ambiguous
There is one other nonconformist in the room	Others conform first
Responses are made anonymously	Responses are made publicly

Groupthink

Listen to the Audio

Despite the old proverb, two heads are *not* always better than one, and six can be downright harmful. Probably the best example of this case is the phenomenon of **groupthink**, *a decision-making problem in which group members avoid arguments and strive for agreement*. At first, this might sound like a good thing. Conflicts can be unpleasant for some people and they can certainly get in the way of group decision making. But groupthink does not always promote good decision making.

When group members are more concerned with avoiding disagreements than with generating ideas, three main problems occur. First, group members may minimize or ignore potential problems and risks in the ideas they are considering. The lack of ability to critically question or disagree with ideas means that people will emphasize potential rewards and successes and overlook potentially disastrous things that might go wrong. Second, groups will likely settle too quickly on ideas, because social pressures will make people uncomfortable with prolonging a decision-making process. Instead, they will simply agree with one of the existing ideas. As a result, many potential ideas are never brought to the table for consideration. Third, groups often become overconfident and therefore less likely to carefully examine the consequences of their decisions, leading them to be less likely to learn from their mistakes (Ahlfinger & Esser, 2001; Janis, 1972). All things considered, groupthink seems like a pretty bad outcome!

Historians have implicated groupthink in some truly terrible decisions. There was the 1986 decision to launch the space shuttle *Challenger* despite safety concerns raised by engineers (the shuttle broke apart 73 seconds into its flight, killing seven astronauts) and the 1961 Bay of Pigs invasion, when a U.S.-sponsored military invasion attempting to orchestrate an overthrow of Cuban leader Fidel Castro was soundly defeated. A more recent example comes from the decisions made by the Bush administration in the United States. and the Blair administration in the United Kingdom to start a preemptive war in Iraq. Their justification was that Iraqi leader Saddam Hussein was manufacturing weapons of massive destruction (WMDs), and therefore he needed to be stopped before he could launch them. However, both administrations were widely criticized for seeking and accepting supporting information while ignoring or downplaying conflicting information. Because of the power of groupthink, the leaders became more and more confidant in their use of faulty evidence. Now, more than a decade and a half later, no WMDs have ever been found, thousands of military personnel and over 100 000 civilians died, and that region remains in turmoil.

Some groups are more susceptible to groupthink than others, and psychologists have turned to laboratory research to find out when and why. Their work revealed that when groupthink occurs, there is often a strong or "directive" leader—specifically, an individual who suppresses dissenters and encourages the group to consider fewer alternative ideas (Ahlfinger & Esser, 2001). Also, groups in which members are more similar to each other, especially in shared sociopolitical perspectives, are more likely to fall into groupthink (e.g., Schulz-Hardt et al., 2000).

To Act or Not to Act: Obedience, the Bystander Effect, and Altruism

Listen to the Audio

So far in this module, we have seen that situational factors can have a great impact on behaviour. In some cases these effects happen completely without our awareness; that can certainly be true for mimicry, adopting roles and norms, and participating in groupthink. Although there are many cases in which people do make conscious decisions—particularly with conformity and social loafing, in this section, we turn to situations in which people have to make a decision to act or not to act.

Obedience to Authority

Listen to the Audio

If there was a pivotal world event that stimulated research on obedience, it would have to be the number of military personnel in World War II who committed atrocities. The fact that so many average German citizens actively participated in the rounding up, incarceration, torture, and murder of millions of people must raise the question: Were they already evil people? Or were most of them just normal people following the instructions of their leaders? Most of us believe that *we* would never do such things, no matter how powerful the situation. If we were asked to harm somebody against their will, and we found it immoral, we would say no. Right? The Milgram obedience experiments (1963, 1974) have thoroughly shaken our confidence in that belief. In his now-famous studies, Stanley Milgram showed the world just how powerful authority could be, and how easily otherwise good, normal people could be made to act inhumanely.

Consider what happened in Milgram's study:

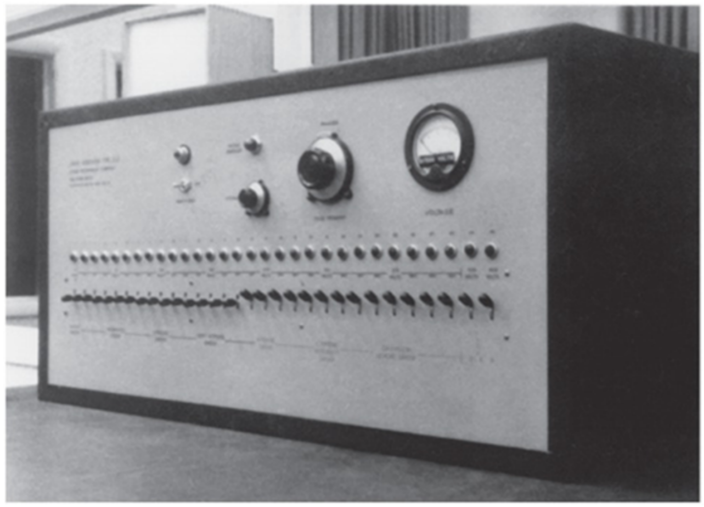
- Participants were told the study is about the effects of punishment on memory. They, and the other supposed participant (who is actually a confederate), a friendly middle-aged man, drew slips of paper in order to determine who would be the "teacher" and who would be the "learner." The draw was secretly rigged so that the participants were always the teacher.

- The teacher's job was to read a series of word pairs to the learner, and then to test him on his memory of the word pairs. The learner was in a separate room hooked up to an electric shock machine. Each time the learner got an answer wrong, the teacher had to administer a shock by flipping a switch on a panel in front of him, and increasing the voltage after each wrong answer. The switches went up by 15 volts until reaching a maximum of 450 volts, which was labelled "xxx." This process was watched by "the experimenter," a man wearing a lab coat.
- As the experiment progressed, the learner started to make sounds of discomfort in the other room, grunting audibly as he was shocked. By 150 volts he was protesting loudly and saying that he no longer wanted to continue in the study. If the subjects continued reading the word pairs and increasing the shock level, the learner got to the point of screaming in pain, demanding and pleading, over and over again, to be let out, pleading that he couldn't take it anymore, even that his heart condition is bothering him, and his heart is acting up. And then, at 330 volts, the learner fell silent and gave no further responses. At this point, subjects were informed by the experimenter that a non-response is to be considered "wrong," and the punishing shock was to be administered.
- If, at any point, subjects expressed concern for the learner, or said that they didn't want to continue, the experimenter simply said a few stock responses, such as "Please continue" or "The experiment requires that you continue."

Milgram's Obedience Experiments

Select the tabs to reveal the equipment and participants associated with Milgram's obedience experiments.

Shock Generator



The “shock generator” that the teacher operated to punish the learner.

The Learner

The Teacher

Unwilling Participant

Source: From the film © *Obedience* 1968 by Stanley Milgram © renewed 1993 by Alexandra Milgram, distributed by Penn State Media Sales.

Now let’s step back for a moment and put the situation in perspective. As part of a psychology experiment, people were asked to shock a person in another room and ignore this person as he expressed increasing discomfort, screaming repeatedly, begging and pleading to be let out of the experiment, angrily refusing to continue, indicating that he might be having a heart attack, and eventually falling completely silent. There is no compelling reason for people to continue, except a man in a lab coat was telling them to do so. What would you do? If you are like most people, you probably feel that you would refuse to continue whenever the “learner” said that he didn’t want to continue (which happened quite early, 150 volts). In fact, a group of psychiatrists at Yale University were

asked to predict ahead of time how many people would obey all the way to the end of the experiment, and they estimated it would be about 1 in 1000—the base rate of sadistic or psychopathic individuals in the population (Milgram, 1974). But overall, Milgram's results were pretty grim: most subjects continued (approximately 65% in most versions of the study), despite the protestations of the learner, simply because an "authority figure" told them to.

It's important to point out that subjects were not sadists, gleefully shocking their partners. Many were deeply distressed themselves, telling the experimenter they didn't want to continue, arguing with him, and so on. As Milgram wrote:

> Subjects were observed to sweat, tremble, stutter, bite their lips, groan, and dig their fingernails into their flesh. These were characteristic rather than exceptional responses. . . . At one point he (one of the participants) pushed his fist into his forehead and muttered, "Oh God, let's stop it." And yet he continued to respond to every word of the experimenter, and obeyed to the end. . . . (1963, pp. 371–378)

Why would people put themselves and another person through such agony just for an experiment? Interestingly, Milgram ran other variants of this experiment, trying to see what might change obedience rates. Milgram tried to reduce the pressure from authority in several ways, such as having the experimenter give orders from another room, by phone. Milgram also tried to increase sense of the learner's distress, such as by having subjects and learners in the same room, and even requiring subjects to physically press the learner's hand onto a shock. Although the rates of obedience are somewhat lower in these experiments, they remained higher than anyone expected (often around 30%). Reducing the appearance of authority and increasing the suffering of the learner clearly helped, but did not resolve the situation.

There were two especially interesting and powerful variations. One experiment looked at whether it is easier for a group to resist the experimenter, pitting the power of the group against the power of authority. In this experiment, there were three teachers making decisions collectively. Two of the teachers were confederates, pretending to be real subjects; the other teacher was the actual subject. When the two confederate teachers made the decision to not continue with the experiment, 90% of subjects also refused. (We would note that it seems surprising that only 90% of them refused, leaving a full 10% of people still obeying the experimenter to the bitter end. Still, 10% obedience is a far cry from the 65% of the original study.) This particular variation is important because it illustrates again the power of dissent. As in the Asch study, if even a couple of people are courageous enough to fight for what is "right," they make it much easier for others to do the same.

Milgram himself believed that these studies provided insight into the horrors of the Holocaust, particularly how so many millions of people could be "evil" enough to willingly participate in the Nazi death machine, or to stand passively by while such a brutal genocide took place.

The Bystander Effect: Situational Influences on Helping Behaviour

Listen to the Audio

As is often the case—as it certainly was for Milgram—a single, shocking, real-world event led to a flurry of psychological research on a social topic; in this case, the topic is why bystanders may or may not help someone in need. The event was reported on the front pages with sensationalized reporting: In the middle of a cold night in 1964, a young woman, Kitty Genovese, was sexually assaulted and stabbed to death outside an apartment building in New York City. The papers said 38 neighbours heard her screams, but did nothing for over 30 minutes. When the police were finally called, they were too late to save Kitty's life. Naturally, people were shocked and outraged that so many could have allowed a young woman to be assaulted without doing anything to help her. How is it possible that not one person intervened? Have we become so selfish and disconnected from each other that we don't get involved even when someone's life is on the line?

Kitty Genovese: Her tragic murder in 1964 led to groundbreaking studies on the bystander effect.

New York Daily News/Getty Images

Before continuing, we should mention that several decades later, the sensationalism in the reporting became more apparent. Far fewer than 38 people actually understood what they were hearing. After all, when you live in a highly populated urban area, it is not uncommon to hear noises, including shouting, in the middle of the night. If you called the police every time someone shouted, they may soon stop taking your calls. So, some of the apparent apathy could have been due to confusion and uncertainty, rather than a lack of caring (Manning et al., 2007). Nevertheless, the event launched an important line of research that found similar effects in many situations.

Watch Under the Influence of Others

Working the Scientific Literacy Model

The Bystander Effect

Listen to the Audio

We have seen how powerful norms can be in shaping behaviour as well as how difficult it can be if you don't follow along. This is definitely true for the *reciprocity norm*, which is basically the social psychology way of saying "we should all look out for each other." This is the norm that leads us to help others while understanding that others will help us. If you drop your keys on the sidewalk, more often than not, someone will call to you and pick up your keys for you. It's a very powerful norm and we respond to it every day. So why does it break down sometimes, as it seems to have done in the Kitty Genovese case?

What do we know about the bystander effect?

Although the Kitty Genovese story was exaggerated in the news, it is an example of individuals failing to help someone in need. This phenomenon is now known as the **bystander effect** (also known as *bystander apathy*), and is *the observation that an individual is less likely to help when they perceive that others are not helping*. Sadly, there are many more stories that tell of similar events. Although they usually unfold in the same way, modern technology adds a new dimension. In 2018, for example, Alexandra Levine wrote in the *New York Times* that she had called for emergency help the prior week when she came across a

woman in a subway station who had fallen down the stairs toward the platform. The station was far from empty, yet everyone else was hurrying past her, some even stopping to catch an image of it on their mobile phones (Levine, 2018).

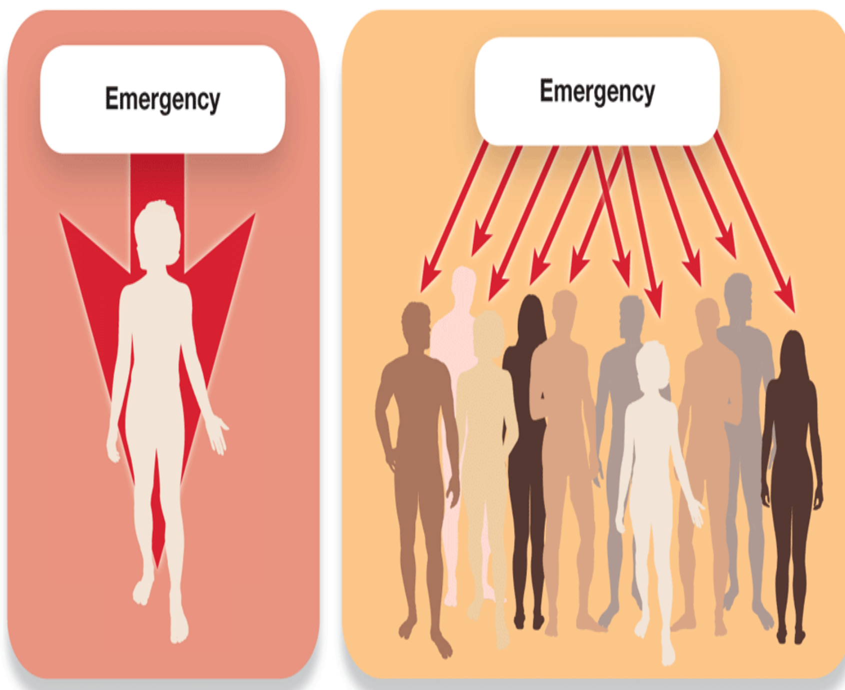
How can science study the bystander effect?

Within months of the Kitty Genovese tragedy, researchers began developing methods of re-creating bystander effects in the laboratory. For example, in one of the first studies, an individual volunteer was ushered into a small room with an intercom under the premise that they would be conversing with other participants (in reality, research confederates) waiting in similar rooms down the hall. As the conversation began, one confederate reported being prone to seizures and subsequently asked for help as a seizure apparently began. The researchers could then observe if the participant helped and if so, how long they waited before acting. Remember, the researchers were interested in how the presence of others might affect a bystander's reaction. Therefore, each time a new participant arrived for the study, the researchers manipulated the number of confederates so that the participant would be talking to one, two, or three confederates. It turns out that the more confederates there were, the longer it took the true participant to react to the calls for help (Latané & Darley, 1968).

Why does the presence of others reduce the tendency to help? If you think of bystander apathy as a type of conformity, you might be able to anticipate the hypotheses they proposed and then confirmed with their experiments. First, there are normative influences. When one person sees another in need of help, they may ask themselves, *What happens if I try to intervene and wind up embarrassing myself?* Second, there are informational influences. The bystander is likely to wonder: *What if the others know*

something I don't? Am I blowing this out of proportion (Karakashian et al., 2006; Prentice & Miller, 1993)? In addition to explanations based on conformity, Latané and Darley also observed **diffusion of responsibility**, *the reduced personal responsibility that a person feels when more people are present in a situation* (Figure 13.2). In other words, if everybody thinks someone else will take on the responsibility of helping, nobody will do anything. These are natural questions and assumptions people make. Fortunately, they do not always result in the bystander effect. This is especially true for bystanders with specific training, such as CPR (Huston et al., 1981), or those with a social connection to the person in need (Levine & Crowther, 2008).

Figure 13.2 Diffusion of Responsibility



If one person witnesses an emergency, it is as if 100% of the responsibility for helping falls on that person. If 10 people witness an emergency, that responsibility is diffused, so it is as if each person feels only 10% of the responsibility—which may not be enough to motivate a person to act.

Can we critically evaluate this evidence?

As the news reports demonstrated, it is important to approach this topic critically. The shocking nature of bystander effects can easily lead to exaggeration and overly emotional thinking. A critical examination reveals that, yes, it does happen, but probably not as often as we think. Critical thinking requires us to consider counter examples: Can you think of situations in which crowds have rushed to help? A quick search on the internet will turn up more stories of compassion and altruism than of bystander effects. Therefore, researchers should also study why people do help, even when it puts them at risk. Finally, the bystander effect can be explained by principles of conformity, but what about personal safety? If someone is being physically attacked or is in some other dangerous situation, should we expect others to put themselves at risk?

Why is this relevant?

To put this topic into context, let us return to the situation where someone is at risk of being assaulted. This is all too common on university campuses where as many as one in five women will report being victim of a sexual assault. A substantial number of these crimes begin at parties and clubs where the victims and perpetrators are presumably surrounded by peers. What if those peers intervened when they noticed one of their friends was behaving aggressively with a woman? Or took a friend home when her judgment had been affected by alcohol so much that she was unaware of a threat? In fact, there are a number of programs designed to reduce the incidence of these types of assaults by educating students and encouraging them to get involved. For example, over 25 years, one U.S. university sponsored seminars to teach students how to spot risks, effective ways to respond, and foster a climate where intervening is

expected. During this period, surveys show that unwanted sexual experiences have been cut by over 50% (UNH, 2012).

When People Decide to Act

Listen to the Audio

If this module is starting to bring you down, don't worry. The world is filled with human beings who have acted—sometimes incredibly bravely—to help others who have been hurt or threatened. To counteract the unpleasant outcomes of the Milgram studies, consider **altruism**—*helping others in need without receiving or expecting reward for doing so*. For an individualistic perspective, altruism can be a bad deal, especially when putting yourself at risk for a complete stranger. However, as you can see in Figure 13.3, people are capable of incredibly heroic acts. The capacity for *empathy*—understanding what another's situation feels like and what its implications might be—is a prerequisite for helping others; the more empathy an individual reports on personality scales, the more likely the person is to help. This is true even if helping requires very little effort (Davis & Knowles, 1999). At the individual level, the willingness to help depends on the situations; after all, some situations seem more urgent than others. Willingness to help can also depend on the individual; some individuals regularly feel more empathy than others. Also, individuals who feel they have a strong, secure bond with family and friends seem to be more likely to help others regardless of their group membership (Mikulincer & Shaver, 2005; Stürmer et al., 2005).

Figure 13.3 Acts of Altruism

Steve Mack/Alamy Stock Photo.

Wesley Autrey, a construction worker in New York City, leapt in front of a subway train to save a complete stranger, Cameron Hollopeter. Hollopeter had fallen on the tracks in the course of having a seizure. As another onlooker held Autrey's daughters in safety, he literally covered

Hollopeter and held him still between the tracks as the train cars rolled just inches above his body. It was such a close call that Autrey emerged with grease from the train's undercarriage on his hat. Autrey’s act was an amazing example of altruism, as he could not have possibly considered any benefit to himself at the moment of his brave act.

As a teenager in Pakistan, Malala Yousafzai had clear orders from an all-powerful authority—one far more threatening than in any social psychological study—and yet she made the choice to disobey. The Taliban had established a police state in her village and, among other things, forbade girls from getting an education. However, Malala insisted on going to school and, for this, she was shot in the face by a Taliban gunman. She miraculously survived and is now an international advocate for women's and girls' rights—and the recipient of a Nobel Peace Prize.

Paul Pickard/Alamy Stock Photo

Module 13.1 Summary

Listen to the Audio

13.1a Know . . . the key terminology associated with social influence.

Review Module 13.1

Start Over Swap

0/11 REVIEWED · 0 MASTERED

social norms

Previous Next Got It!

13.1b Understand . . . why individuals conform to others' behaviours.

At its most basic level, conforming begins with mimicry, in which people simply imitate others' behaviours. Mimicry seems to help form social

bonds and encourages prosocial, helping behaviour. Conformity usually describes the way an individual's more complex behaviours evolve to become like the behaviours of the group. People may conform because they want to be accepted by the group, or they may conform because the group's way of perceiving reality actually influences the person's own perceptions.

13.1c Understand . . . how individuals and groups can influence behaviours.

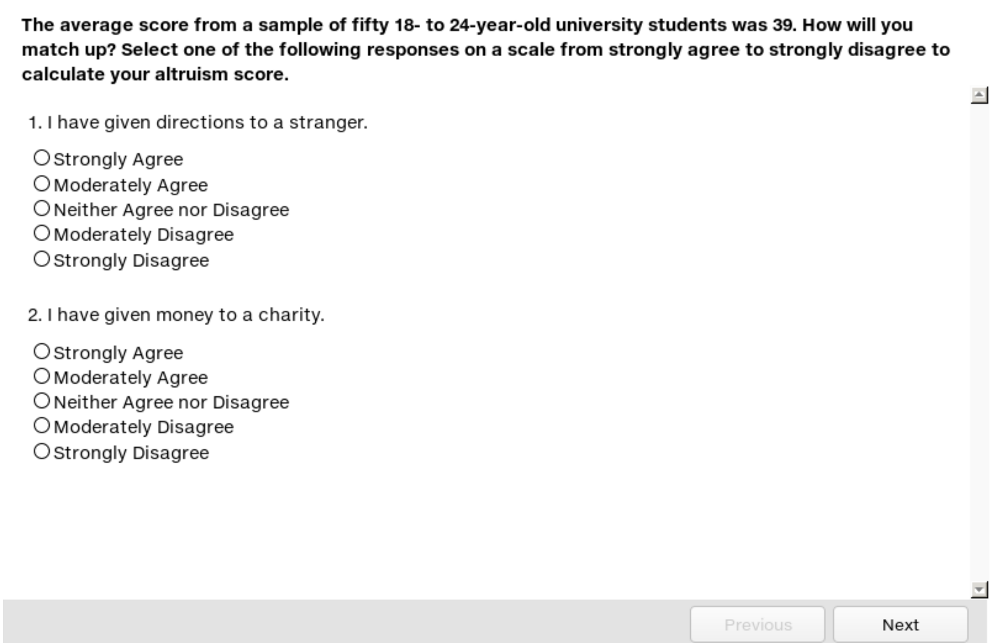
In many different situations, other people can change how we behave. In helping situations, the presence of others tends to decrease the likelihood that someone will help another in distress. In other situations, the presence of even a few more people can set up conformity pressures that influence us to behave like the others in the group. Interestingly, these conformity pressures can be largely eliminated in at least some situations if even a single individual is willing to go against the group and break its unanimity. In many situations we are placed into social roles and feel like we have to live up to the responsibilities of that role, even if we would normally behave differently. When authority figures are involved, these social pressures can become even more powerful—so powerful that many people cannot resist complying.

13.1d Apply . . . your knowledge of being a passive bystander or active altruist to understand your own likeliness to help.

People are least likely to help if they don't feel personally responsible for taking action, if they are unsure what to do to help, or if they are unsure whether the situation is a genuine emergency. Thus, you can best ensure that others will help you if you make very clear that it's an emergency and you need help, if you make a specific person responsible for helping, and

if you tell that person exactly what he or she needs to do. Additionally, some people just tend to be more altruistic than others.

A Self-Report Altruism Scale


The average score from a sample of fifty 18- to 24-year-old university students was 39. How will you match up? Select one of the following responses on a scale from strongly agree to strongly disagree to calculate your altruism score.

1. I have given directions to a stranger.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

2. I have given money to a charity.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

Previous Next

Source: Adapted from Rushton, Chrisjohn, & Fekken, 1981.

13.1e Analyze . . . whether people who harm others are fundamentally hurtful, mean people or if their behaviour is the product of social influences.

Behaviour is a function of the person and the situation. Therefore it is impossible to say in general the extent to which guards who participate in abuse or teachers who shock learners are driven by their own character traits or by situational forces. A full analysis must take both sets of factors into consideration. Clearly though, in situations in which people feel they are carrying out the responsibilities of their role, peer pressure is exerted through the expectations and behaviours of others, and the authorities demand the behaviour, it becomes far more likely that some people will

act in ways that even they themselves would not have expected. Nevertheless, even the strictest social psychological analysis would never remove the final responsibility from the person. No matter the situation, we can always choose how to respond.

Module 13.2 Social Cognition

Listen to the Audio

Stephen Chernin/AP/Shutterstock

Learning Objectives

13.2a Know . . . the key terminology associated with social cognition.

13.2b Understand . . . how we form first impressions and how these impressions influence us.

13.2c Apply . . . your knowledge of attributions and biases to better understand how you tend to perceive yourself and others.

13.2d Analyze . . . whether people who commit discriminatory acts are explicitly prejudiced.

One February night in 1999, four New York City plainclothes police officers were patrolling a Bronx neighbourhood when they saw a lone man on the street. The officers thought he was behaving suspiciously, so they decided to question him. Upon orders from the police to stop, the man ducked into the vestibule of an apartment building, reaching for the door with one hand and putting the other into his pocket. Officers feared he was reaching for a gun and opened fire. Nineteen of the 41 shots fired hit the man and killed him on the spot.

Tragically, the victim of the shooting was a peaceful and unarmed 24-year-old man named Amadou Diallo. By all accounts, Diallo was a friendly, industrious, and law-abiding man from West Africa, who had come to New York in hopes of attaining a college education. Why didn't he just obey the officers? He presumably didn't know the men were police (they were not in uniform and were driving an unmarked car). Besides, whenever four guys jump out of a car in the middle of the night in the Bronx and start yelling, running into the safety of your home is a sensible thing to do.

Much of New York was in an uproar over the shooting, and the turmoil was only heightened after the four police officers were found not guilty of any criminal wrongdoing. Half of all New Yorkers disagreed with the verdict, and that figure reached almost 80% among Africans and African Americans (Connelly, 2000).

In the 20 years since Diallo's death, we have seen many more events of this type. People of all backgrounds attributed the shooting to hostile prejudice. On the other hand, many other people and most police officers defended the actions of the four officers, blaming the stressful environment in which they work and the need for them to make a snap decision in a potentially life-threatening situation. Notable movements such as Idle No More and #BlackLivesMatter have created not only robust and healthy communities, but also a massive increase in public awareness, boots-on-the-streets activism, and meaningful political dialogue and change.

Central to issues of race, class, gender, sexual orientation, and all other forms of discrimination is understanding how human beings actually do process information about the social world, and how stereotypes, prejudice, and other social processes influence people's perceptions and behaviours. These are the questions we explore in this module.

The field of social-cognitive psychology is a fusion of social psychology's emphasis on social situations and cognitive psychology's emphasis on cognitions (perceptions, thoughts, and beliefs). Social-cognitive researchers study the cognitions that people have about social situations, and how situations influence cognitive processes. It is an exciting area to study because it deals directly with the everyday social experiences we encounter in our lives.

One of the central ideas in this field is that there are two major types of processes in our consciousness: explicit processes and implicit processes.

Explicit processes, *which correspond roughly to "conscious" thought, are deliberative, effortful, relatively slow, and generally under our intentional control*. This explicit level of consciousness is our subjective inner awareness, our "mind" as we know it. **Implicit processes** *comprise our "unconscious" thought; they are intuitive, automatic, effortless, very fast, and operate largely outside of our intentional control*. The implicit level of consciousness is the larger set of patterns that govern how our mind generally functions—all the "lower-level" processes that comprise the vast bulk of what our brains actually do (Chaiken & Trope, 1999; Kahneman, 2003; Todorov et al., 2005).

These two sets of processes work together to regulate our bodies, continually update our perceptions, infuse emotional evaluations and layers of personal meaning to our experiences, and affect how we think, make decisions, and self-reflect. But not only do these two sets of processes carry out their independent functions, they also can influence each other. For example, explicit processes influence implicit processes when our beliefs (e.g., my friend Bob is a kind person!) influence how we process information (e.g., how much attention we pay to Bob's positive and negative behaviours). On the other hand, implicit processes can influence explicit processes, such as when our automatic tendency to categorize a person into a stereotyped group influences the judgments we make about that person. Explicit and implicit processes are intertwined, each influencing the other as we navigate the social world. In social-cognitive psychology, *models of behaviour that account for both implicit and explicit processes are called* **dual-process models** (Chaiken & Trope, 1999).

One of the major contributions that this understanding has given us is how our conscious acts are conditioned or influenced by a huge amount of unconscious processing. For example, when a person makes a specific choice to do something, that decision occurs *after* a whole slew of

processes have already occurred—the person paying attention in the first place (choosing some parts of reality to focus on and ignoring many others), interpreting information into an overall understanding, evaluating different pieces of information, and forming judgments and beliefs. So, who really made this decision then? And how can you say that it was a conscious act, if the vast bulk of the processing was actually unconscious? The critical insight is that because implicit processes happen so quickly and subtly, our presumably conscious and intentional acts are constantly being influenced and guided by our implicit processes, and we are not generally aware of this at all.

Consider the police officers in the Amadou Diallo shooting. As soon as they saw a Black man on the street late at night in the Bronx, a "Black male stereotype" may have become implicitly activated (Bargh, 1999). This stereotype then would have guided their explicit thinking, resulting in tragedy. Indeed, the Black stereotype may have influenced their very first moment of interpretation, which was that Diallo was "acting suspiciously." It would have continued to influence the officers' interpretations of the rest of Amadou's behaviours, until the critical moment, forming the perception that he was reaching for a gun.

That's the double-edged sword of implicit processes; they help us process information efficiently, but they do so through creating biases. And when these biases lead to bad judgments or decisions, it is very difficult to recognize this or fix it, because we are not consciously aware of these implicit processes at work.

Person Perception

Listen to the Audio

The effects of implicit processes are dramatically illustrated by research on **person perception**, *the processes by which individuals categorize and form judgments about other people* (Kenny, 2004). Person perception begins the instant we encounter another person, guided by our past experiences with people and the interpersonal knowledge we have absorbed from our culture. When we make a first impression of someone, we rely heavily on implicit processes, using whatever *schemas* we may have available. Schemas are organized clusters of knowledge, beliefs, and expectations about individuals and groups that influence our attention and perceptual processes in many ways (see Module 7.3). For example, a person's visible characteristics (e.g., gender, race, age, style of dress) all activate schemas, and these schemas can bring certain traits to mind automatically.

Thin Slices of Behaviour

Listen to the Audio

One amazing aspect of these implicit processes is just how accurate and practically instantaneous they can be. For example, within the first minute of seeing your professor at the front of the room, you have already evaluated them and made some basic judgments. If you were to fill out your course evaluations after, say, one minute of the first class (which would seem highly unfair!), your ratings would likely be very similar to your course evaluations after an entire semester's worth of exposure to that person (Ambady & Rosenthal, 1993; Tom et al., 2010). What happens in these situations is that we make very rapid, implicit judgments based on **thin slices of behaviour**, *very small samples of a person's behaviour*. In even a few seconds, our implicit processes, guiding our perceptions holistically and using well-practised heuristics, are able to perceive very small cues and subtle patterns. This gives us instantaneous, intuitive accuracy, at least in part.

Surprisingly, many of our social judgments are made in this way—instantaneously, based on very little information. Whether it's judging people based on tiny snippets of conversations we happen to overhear (Holleran et al., 2009; Mehl et al., 2006), or catching a mere glimpse of their face (e.g., we judge trustworthiness, competence, likability, and aggressiveness after seeing a photograph for less than one second; Willis & Todorov, 2006). Research by Nicholas Rule from the University of Toronto has shown that we can tell surprising things about people given incredibly little information. For example, people can guess a male's

sexual orientation at rates greater than chance after viewing his photograph for a mere 1/20th of a second (Rule & Ambady, 2008), and Americans can accurately guess whether other people tend to vote Republican or Democrat merely by looking at a photograph of their face (Rule & Ambady, 2010). Republicans are viewed as having more powerful faces, but Democrats are seen as warmer.

Thin-slice research demonstrates just how quickly impressions are formed, and how surprisingly accurate they often can be. Of course, they are not perfectly accurate, and therein lies the problem.

Self-Fulfilling Prophecies and Other Consequences of First Impressions

Listen to the Audio

First impressions have a big impact on many of our social behaviours. Even very simple cues, such as facial appearance, guide a wide range of behaviours, from how a jury treats a defendant to how people vote. For example, one study asked participants to act as jurors and evaluate evidence against a defendant. If shown a photograph of a defendant who simply "looked more trustworthy," participants were less likely to come to a guilty verdict (Porter et al., 2010). In another study, the outcome of U.S. elections of congressional candidates could be predicted 70% of the time simply using participants' judgments of how competent the candidates appeared in photographs (Todorov et al., 2005).

The fact that our implicit judgments can influence our perceptions and behaviours has countless implications for our social lives, particularly in terms of **self-fulfilling prophecies**, *which occur when a first impression (or an expectation) affects one's behaviour, and then that affects other people's behaviour, leading one to "confirm" the initial impression or expectation*. For example, if you expect someone you meet to be warm and friendly, you will probably be more at ease with them and will treat them in a warm and friendly manner yourself. This friendly behaviour will make them comfortable and will lead them to behave warm and friendly in return, leaving you with the conclusion that they are—surprise!—warm and friendly. You can easily imagine the opposite process, if your initial expectation is that the person will be cold and unfriendly.

Thin slices of behaviour research shows that, in mere seconds, people form impressions that are surprisingly accurate. For example, you could get students to fill out course evaluations in university, evaluating the teaching capability of their professor, in the first minute of the first class, and they would be about the same as ratings taken after an entire semester of being taught by that professor.

Left: Monkey Business Images/Shutterstock; Right: Glow Asia RF/Alamy Stock Photo

Self-fulfilling prophecies affect our lives in many different ways. For example, if a person is confident, they are going to behave differently than if they assume they are going to fail, nobody is going to like them, and they will continue to be a loser. It's the difference between the socially confident person who goes to a party where they don't know anybody and end up having the best time and talking to all sorts of great people; versus the person who goes to the party and expects that it will be awkward and nobody will like them, so they hang back, keep to themself, don't initiate many conversations, and are stiff and uncomfortable, so that they end up not having a very good time after all. "See, I knew it all along . . . I shouldn't have gone in the first place. . . " is a self-fulfilling prophecy.

This idea has truly caught fire in North America society because it fits in so well with the "positive thinking" paradigm that so many people believe. And indeed, there is some sense to this. Every coach, athlete, parent, teacher, and anyone who has been a child at some point knows that, in the moment, if a person has no confidence and assumes "I can't do it," then they're right; they can't. This is one of the basic lessons of growing up that we all learn at some point; you have to believe in yourself. Because if you don't, your lack of belief becomes a self-fulfilling prophecy. This is one way that our implicit processes shape our social realities.

The Self in the Social World

Listen to the Audio

How do we decide what information to use when we're trying to understand other people or form impressions of them? What schemas do we activate to guide our judgments? As discussed above, we may use subtle cues in people's faces or non-verbal behaviours, but what else guides our judgments? Certainly, if the person falls into a group about which there are specific stereotypes, such as categories based on race, class, and gender, then these stereotypes often are automatically activated and can colour our judgments (Bargh, 1999). But one additional schema that is highly accessible, contains a vast amount of information, and is therefore often used in guiding our social judgments—ourselves! Much of the time, we look out at the social world through the lens of our own self-concepts.

This has two very important consequences. The first is that we tend to think that the way we are is the way people *should* be, and therefore, people who are substantially different from us have something wrong with them. The second is that we have a strong tendency to split the world into *Us* and *Them*, and we are motivated to see *Us* more positively than how we see *Them*. Understanding these dynamics gets right to the heart of why there is so much intergroup hostility in the world. It also reveals a tragic irony, which is that in the quest to feel good about ourselves and be happy, we sow the seeds that will grow into distrust, prejudice, and discrimination, thereby causing much suffering and

unhappiness. Let's examine these arguments carefully, because they have major implications for understanding why the world is the way it is.

Projecting the Self onto Others: False Consensus and Naïve Realism

Listen to the Audio

One way in which our self-concept affects our social perceptions is that we tend to *project* our self-concepts onto the social world; this means that the qualities we see in ourselves and the attitudes and opinions that we hold, we tend to assume are similar for society at large. If we are sports fans, we assume that sports is generally important for other people as well. Even qualities we have that we know are not popular are still projected onto society. So, for example, if we are believers in Scientology, we will tend to assume that a larger proportion of the population believes in Scientology than is likely the case, and we will assume there are more Scientology believers out there than a non-believer would assume. *This tendency to project the self-concept onto the social world* is known as the **false consensus effect** (Marks & Miller, 1987). It's important to understand that this is a pretty sensible way to be, much of the time. After all, if we have to make guesses about people, why not base these guesses on ourselves?

We also generally assume that *our perceptions of reality are accurate, that we see things the way they are*; this is called **naïve realism** (Ross & Ward, 1996). And it makes sense that we would make this assumption. After all, who wants to assume that they are walking around deluded and wrong all the time? Imagine being beset by doubts constantly, your life uncertain and stressful because you are never able to trust your own judgments. So instead, we operate under a basic framework of "I make sense," and then,

by extension, “the people that I agree with, who are kind of like me, also make sense.” And then, of course, by one more extension, “the people who I disagree with are deluded, wrong, and quite fundamentally different from me.” You can see the problem here. At the personal level, we just want to feel good about ourselves and function effectively in the world. But at the group level, we create intergroup biases and an *Us* vs. *Them* way of thinking.

Self-Serving Biases and Attributions

Listen to the Audio

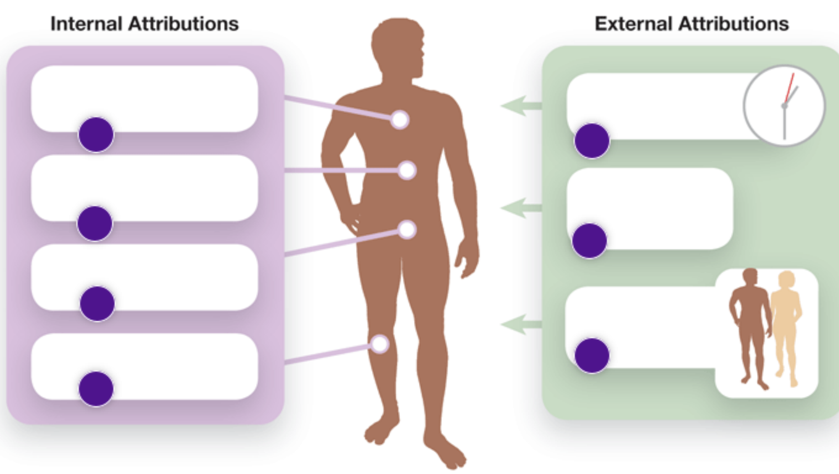
This tendency toward naive realism reflects a larger, more general need to want to feel positively about ourselves, to have a positive sense of self-evaluation or self-esteem (Allport, 1955; Maslow, 1968; Sedikides & Strube, 1995). Undergraduate students clearly enjoy boosts to their self-esteem, reporting to prefer receiving such a boost even overeating a favourite food, getting paid, having sex, or seeing a best friend (Bushman et al., 2011). We strive to maintain our positive self-feelings through a host of **self-serving biases**, *which are biased ways of processing self-relevant information to enhance our positive self-evaluation* (Miller & Ross, 1975). For example, we tend to take credit for our successes but blame our failures on other people, circumstances, or bad luck. Interestingly, for many of the qualities and skills that are important to us, we assume that we are "better" than average. This rather appropriately named *better than average effect* has been shown in many domains. In one study of almost one million American students, a whopping 85% viewed themselves as "above average" in their ability to get along with other people, and a full 25% believed they were in the top 1% of this ability (Alicke & Olesya, 2005). If only the laws of math would allow this to be true. . . .

These same self-serving processes also influence the way we explain or interpret people's behaviour. Much in the same way that first impressions are formed implicitly (which we discussed earlier), our explanations for behaviours tend to start out as automatic and seemingly intuitive. Imagine that you're driving down the highway and all of a sudden some

other driver swerves in front of you, honking. You slam on the brakes and turn the wheel sharply, narrowly avoiding a collision. Quick—what is the first thing that comes to mind about the other driver? Probably, your first thought is not the kindest or gentlest. You assume the other driver is an aggressive jerk or maybe a bad driver. You yell, "You idiot!" and shake your fist, which of course makes them feel shame. This type of explanation is called an **internal attribution** (also known as a *dispositional* attribution), *whereby an observer explains the behaviour of an actor in terms of some innate quality of that person* (see Figure 13.4). In other words, you *(the observer in the above example)* explain the actor's behaviour *(the driver who cut in front of you)* as an internal part of who he is as a human being *(being an aggressive jerk, bad driver, or all-around "idiot")*.

Figure 13.3 Internal and External Attributions

Internal attributions are based on qualities or actions of the individual, whereas external attributions focus on the context in which the individual is situated.



But of course, there may be other reasons for the driver's behaviour. Perhaps he is swerving out of the way of a piece of debris on the road, or just blew a tire, or just received a phone call that his partner is in the hospital and is distracted, or he's tired after a long day and didn't look in his blind spot that one crucial moment before swerving in front of you. These are **external attributions** (also known as *situational* attributions), *whereby the observer explains the actor's behaviour as the result of the situation* (Heider, 1958). Generally, these external attributions are not what first come to mind; rather, we come to them after thinking about it for a bit, and realizing that maybe there were other factors causing the person's behaviour that we didn't initially consider.

This *tendency to over-emphasize internal (dispositional) attributions and under-emphasize external (situational) factors when explaining other people's behaviour* is known as the **fundamental attribution error (FAE)** (Ross, 1977). On the other hand, when we explain *our own* behaviours, we tend to emphasize whichever kind of explanation paints us in the best light. For our negative behaviours, the mistakes we make and embarrassing things we do, our attributions are much more generous. We emphasize the situational factors that cause us to do undesirable things (e.g., we had a headache, we were under a lot of stress, a family member was sick, and so on). This bias may seem a little selfish, but there is reason to believe it contributes to well-being. For example, people with severe forms of depression and anxiety appear much less susceptible to the self-serving bias—by perhaps as much as 50% (Mezulis et al., 2004). Thus the self-serving bias might actually reduce our chances for psychological distress. However, it also might prevent us from taking responsibility for negative behaviours sometimes.

One rather ironic wrinkle in the story of the FAE is that it doesn't seem to be quite as "fundamental" as was originally thought. Research on cross-cultural differences has shown that people make the FAE the most in

predominantly individualistic cultures such as Canada or the United States, and the least in more collectivistic cultures such as China or Japan. This different approach to explaining others' behaviour can be seen in how people interpret social events such as news stories. For example, after reading about recent mass murderers in the newspaper, subjects from China are more likely to emphasize situational explanations for the murders (such as recent stressful events in the person's life), whereas North American subjects are much more likely to emphasize dispositional explanations (such as the murderer being an evil person; Morris & Peng, 1994). This greater emphasis on situational factors in collectivistic societies reflects stronger values toward maintaining harmony in interpersonal relationships and fulfilling a person's social roles in the larger community, values that lead people to be more aware of situational information (Choi et al., 1999; Nisbett, 2003).

Ingroups and Outgroups

Listen to the Audio

Although this desire to feel good about ourselves seems functional and healthy, it often has negative side effects. As we discussed earlier, our self-serving processes also reinforce a tendency to be biased against others. We are motivated to be biased against others because one of the key ways we maintain positive feelings about ourselves is through our identification with larger social groups (Fein & Spencer, 1997), and we can therefore make ourselves feel good by feeling positively toward these groups. In turn, one way to feel positively about our own group is to focus on how much better we are than other groups we compare ourselves to. *Groups we feel positively toward and identify with* are our **ingroups**, including our family, home team, and coworkers. In contrast, **outgroups** *are those "other" groups that we don't identify with*. In fact, we actively *dis*-identify with outgroups.

This is where our self-serving biases can be so destructive. *As positive biases toward the self get extended to include one's ingroups, people become motivated to see their ingroups as superior to their outgroups—engaging in* **ingroup bias** and, potentially, outgroup derogation. All in the service of maintaining our self-esteem, we carve the world into categories of *Us* and *Them* and then we automatically show a preference for *Us*.

A set of studies that began in the 1970s added a crucial insight to the discussion of how we process information about groups. In real-world social interactions between people, there is already a lot of relevant group

information available simply based on the physical characteristics of the individuals. Rather than creating groups based on established characteristics such as ethnicity or gender, researchers using the *minimal group paradigm* divided participants into new groups based on essentially meaningless criteria. In different studies, people were divided into groups based on whether they preferred one painting over another (Tajfel, 1970; Tajfel et al., 1971), or whether they flipped heads or tails on a coin toss (Locksley et al., 1980). These newly formed groups had no history, no actual affiliation with each other, and no future together after the experiment was over.

Amazingly, even these completely meaningless ways of forming groups are enough to drive prejudice and discrimination. For example, if people are asked to distribute money between the two groups, they consistently give more to their new ingroup members. These results suggest that the process of categorizing the world into *Us* and *Them* is a fundamental and practically unavoidable part of how we process the social world. It also has some sobering implications. If the people in the group who flipped heads in a coin toss prefer their fellow Heads over those nasty Tails, even though they have no history of animosity, no competition over resources, or any other grounds whatsoever on which to base their preferences, imagine how much more powerful people's biases will be when faced with real-world distinctions and long histories of conflict and violence. Appreciating the deeply biasing influences of making ingroup–outgroup distinctions in the first place adds an important layer to our understanding of these larger conflicts.

Social psychology tends to focus on processes that have caused social problems. Because of this, the field is sometimes accused of making people look silly, arrogant, or mean, but that is not the intent. So, in closing this section, we want to make sure you remember that all of these processes serve important functions for us. Without the false consensus

effect and our tendency to project our self-concept onto others, we would be in a great deal of uncertainty about what other people are like; it would be like living on a planet of mysterious and unpredictable aliens. Without naïve realism, we would be plagued by doubts and would constantly second-guess our perceptions of the world. Without a positive sense of self-evaluation, it would be easy to feel useless, helpless, and generally miserable. Without the ability to attach ourselves to desired ingroups and distance ourselves from undesired outgroups it would be hard to feel a sense of belonging (Cacioppo et al., 2003; Myers & Diener, 1995; Tajfel & Turner, 1986). From that perspective, social psychology should be seen as a tool for helping us appreciate and respect each other a little bit more.

Stereotypes, Prejudice, and Discrimination

Listen to the Audio

Obviously, the roots of prejudice are planted very deeply in our psyches, stemming ultimately from our deep-rooted attachment to our own selves and our automatic social categorization tendencies. Thus, while at the explicit level we may strive to be egalitarian and not discriminate based on dimensions such as race, class, and gender, our normally functioning implicit processes continually split the world into *Us* and *Them*. In fact, using ERP technology to measure brain activation, research has shown that the perceptual system starts to react differently to people based on race and gender within a mere 200 milliseconds (Ito & Urland, 2003). When we try to change these implicit tendencies, we are battling our vast and speedy implicit system with our weak and ponderously slow explicit system. Much of the time, our explicit, consciously controlled self is going to lose, and we will fall prey to our implicit biases. These implicit biases lay the foundation for stereotyping, prejudice, and intergroup discrimination.

From a social-cognitive perspective, a **stereotype** *is a cognitive structure, a set of beliefs about the characteristics that are held by members of a specific social group; these beliefs function as schemas, serving to guide how we process information about our social world*. Based on stereotypic beliefs, **prejudice** *is an affective, emotionally laden response to members of outgroups, including holding negative attitudes and making critical judgments of other groups*. Stereotyping and prejudice lead to **discrimination**, *behaviour that*

disfavours or disadvantages members of a certain social group. Taken together, stereotyping, prejudice, and discrimination underlie many of the destructive "isms" in society—racism, sexism, and classism, among others. One of the central goals of social-cognitive psychology has been to understand how these processes work.

Myths in Mind

Are Only Negative Aspects of Stereotypes Problematic?

When thinking about stereotyping, the first examples that come to mind are usually based on negative characteristics. However, it is certainly not the case that all stereotypes sound negative. Masculine stereotypes include qualities such as determination and toughness—those can be admirable qualities, right? What might be counterintuitive to many people is that even the positive aspects of a stereotype carry a kind of hidden danger, leading to a tendency for people to believe it is okay to emphasize the positive aspects of a stereotype in a "benevolent or well-intentioned way." This has been examined a great deal with regard to sexism. Researchers have distinguished between *hostile sexism*, or stereotypes that have explicitly negative views of one or both sexes, and *benevolent sexism*, which includes views of one or both sexes that sound positive (Glick & Fiske, 1996, 2001). For example, consider the dated saying that women are "the fairer sex." A person using this phrase may mean it as a compliment, implying that women are virtuous, nurturing, and empathetic.

However, even stereotypes that a person may defend as being "well-intentioned" can place restrictions on an individual's behaviour. If we consider women to be "virtuous," they may be

held to different sexual standards than men and, as a result, may be judged more harshly when they violate those standards. Similarly, considering women to be nurturing and empathetic reinforces the notion that women are the primary hubs of family life, and therefore less inclined toward career advancement in our competitive world. Even when women go toe-to-toe with men in the workplace, they may be hindered in careers that call for assertive or aggressive behaviours (such as being successful in the business world) because the “fairer sex” stereotype is pervasive in the organization (Glick & Fiske, 1996, 2001). Finally, you do not have to be a member of the stereotyped group to be harmed by benevolent stereotypes. If women are the nurturers, men who are seen as kind and nurturing will be seen as less masculine. Thus, even seemingly positive stereotypes can result in negative, unforeseen consequences. The same is true for other forms of stereotypes as well; if you think about all the types of people in the world, you can probably find examples of hostile and benevolent racism or any other stereotypes.

Prejudice in a Politically Correct World

Listen to the Audio

Recent decades have seen incredible changes in acceptance of and sensitivity toward social diversity and equality. Along with this acceptance, a large part of the population gladly accept changes in the words we use to describe each other. These people view language as a way of being respectful. However, others sometimes disparagingly call it "political correctness (or being PC)." This label suggests that the battles for equality are basically over and everyone has equal opportunities and freedoms. If that is the case, then asking for sensitivity and respect comes across as demanding special attention or "playing the race card." The truth is quite different. Outgroup stereotypes and prejudices are by no means a thing of the past, and neither are the discriminatory practices that go along with them.

In the United States, despite the victories of the civil rights movement in shifting the racial attitudes of the general North American population, there is still prejudice toward non-White cultural groups. For example, it still seems as though members of these groups experience the legal system differently from others. In Canada, people of Indigenous descent (about 5% of the national population) made up over 25% of the intakes in provincial and federal prisons (Statistics Canada, 2018). A review of the Toronto Police Department found that Black men were 20 times more likely to be arrested than their White counterparts, and Black people were 20 times more likely to be killed by police action than White people (Ontario Human Rights Commission, 2018). This is not just a Canadian

phenomenon. In the United States, Black men are incarcerated far more often than any other groups (Smith, 2004). Records of police encounters over the past 30 years confirm what many minority groups have long claimed—that the police use more aggressive techniques on minority suspects than White suspects (Smith, 2004; Weitzer & Tuch, 2004), making them three to five times more likely to die in police confrontations than White suspects (U.S. Department of Justice, 2001; Centers for Disease Control, 2019).

This prejudice has seeped into the basic social-psychological functioning of many people. For example, even though the general public denounces prejudice and discrimination and holds values of universal equality, studies of implicit processes tell a different story. When people (generally, White people) first are exposed to Black faces, this automatically influences a variety of physiological responses, including the activation of facial muscles, cardiovascular responses, and brain activity related to fear and negative emotions (Cunningham et al., 2004; Eberhardt, 2005).

In fact, measures of brain activity reveal the battle between implicit and explicit processes. Over very short amounts of time, exposure to White or Black faces activates implicit processes such as those described above, indicating a racially biased pattern of processing. However, over longer periods of time, such as 30 seconds, brain activity shifts, showing heightened activity in the prefrontal cortex. This area relates to the control of emotions and abstract thinking, consistent with a neurological effort to bring values into our mind in order to control emotional reactions. This teaches us a powerful lesson: Even if people abhor prejudice at the explicit level of their awareness, they may *implicitly* hold negative stereotypes and experience prejudiced emotional reactions.

Clearly, there can be important discrepancies between stereotyping, prejudice, and discrimination at the explicit and implicit levels. This has

created huge challenges for researchers attempting to study these processes, because of course simply asking subjects how they feel is only going to reveal their explicit processes, which rarely include overt racism and sexism. This has led to the invention of measurement techniques to try to reveal implicit processes.

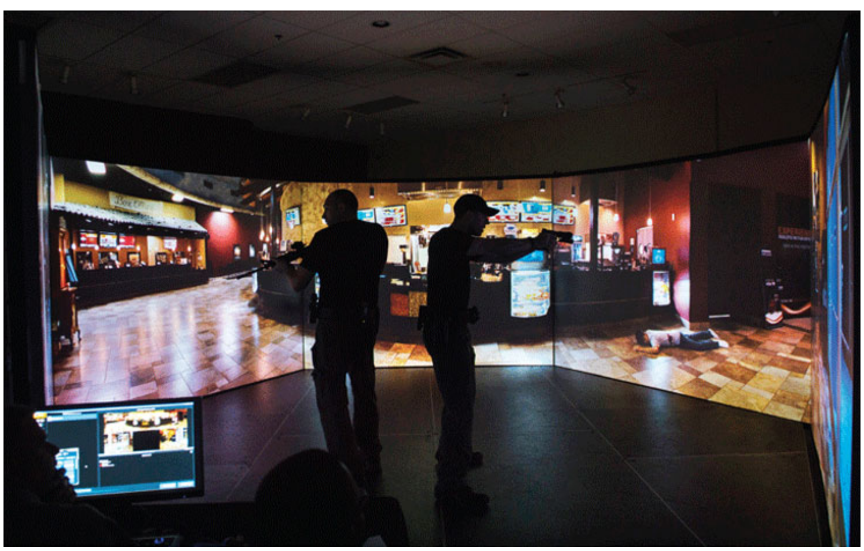
Psych@

The Law Enforcement Academy

Think back to the story of Amadou Diallo that introduced this module. Imagine that instead of linking positive or negative terms with Black faces in the IAT, you were asked to make a snap decision whether or not to shoot a potential criminal. A number of researchers have used video-game-like tasks to put participants in these situations. In these video simulations, a figure will suddenly appear, either holding a weapon or a non-weapon (e.g., a wallet or a cell phone). It turns out that when making these split-second decisions, people are a little bit slower to decide whether or not to shoot a Black man holding a non-weapon, and they make the wrong decision more often. When a Black man is holding a gun, however, they make the "shoot" decision more quickly than if the gun is held by a White man (Correll et al., 2007; Correll et al., 2006). The logic is similar to the IAT discussed above. Because Black and "gun" are stereotypically consistent with each other, people have an easier time processing these stimuli together than when Black and "wallet" are paired with each other. Just like the situation in the Amadou Diallo case then, people are more likely to mistakenly shoot a Black man holding a wallet, believing that

he might be holding a gun; at least, they're more likely to do this in a video game.

Certainly a video game pales in comparison to the adrenaline-fuelled confrontation that occurred that fateful night in the Bronx. It is easy to imagine that the stress of a real confrontation, combined with the complexity of a real-world situation, would lead to an even higher chance of a mistaken shooting occurring (Saus et al., 2006). To combat any implicit influence of race on an officer's decision to shoot, most law enforcement agencies in North America have developed extensive training programs, part of which focus on making shoot–don't-shoot decisions (Cordner & Shain, 2011). Programs simulate a variety of firearms combat situations using a combination of virtual reality, physical walk-through sets with cardboard figures, and realistic mock-combat against other people armed with foam pellet guns. Research suggests that this training is helpful; even student volunteers in the lab can be trained to reduce shooting errors through such means (Correll et al., 2007; Plant & Peruche, 2005).



The split-second differences in the IAT may be related to officers' increased use of deadly force with Black suspects,

including cases where the suspect is unarmed. Here, police officers engage in virtual reality training designed to reduce shooting errors.

ZUMA Press/Newscom

Working the Scientific Literacy Model

Explicit versus Implicit Measures of Prejudice

Listen to the Audio

If a great deal of modern prejudice has "gone underground" in the sense that people hide it and give politically correct responses at the explicit level, how can researchers accurately measure prejudice in today's society?

What do we know about measuring prejudice?

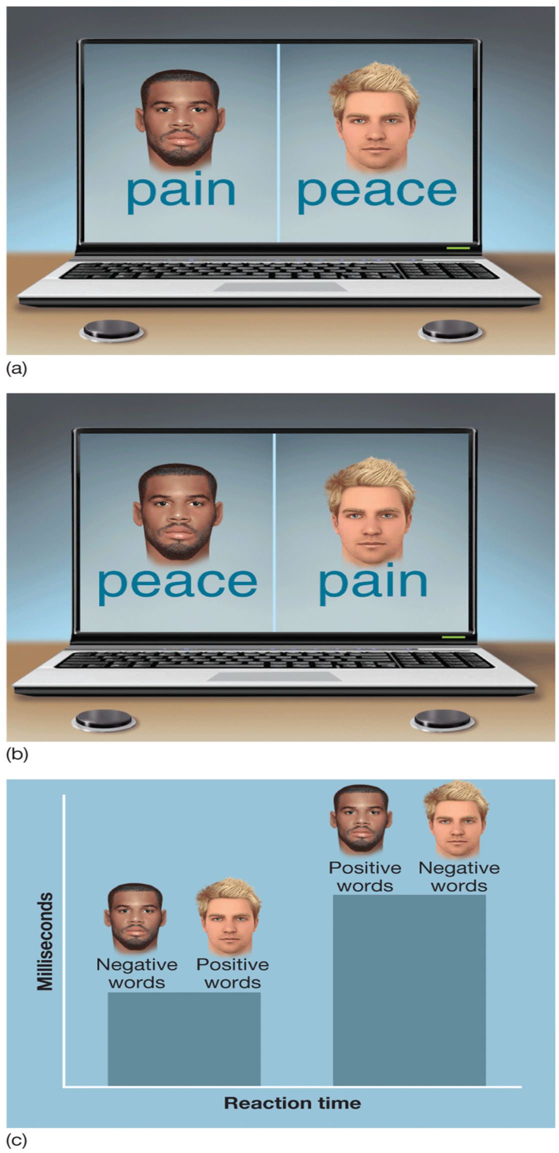
Psychologists have developed clever ways of measuring the forms of stereotyping and prejudice that are kept silent, either intentionally or because individuals are unaware of their own prejudices (Greenwald & Banaji, 1995; Nosek, 2007). In order to do so, researchers needed to come up with measurement devices that would reveal people's implicit processes. This is no easy challenge, because implicit processes can operate so quickly (in less than a second), and so subtly that we are typically not consciously aware of them.

How can science study implicit prejudice?

A major research breakthrough occurred in the 1990s with the invention of the **Implicit Associations Test (IAT**; Greenwald et al., 1998). The IAT *measures how fast people can respond to images or words flashed on a computer screen*. To complete the test, a person uses two fingers and two computer buttons, and responds to

stimuli, as directed (see Figure 13.5). In the first block of trials, subjects are supposed to press one button if they see a White face or a positive word (such as *peace*), and a different button if they see a Black face or a negative word (such as *war*). Thus, in this round, the buttons are associating stereotype-consistent stimuli. With these particular pairings, it takes people around 800 milliseconds (four-fifths of a second) to press the correct button.

Figure 13.5 The IAT Procedure



To complete one condition in the IAT (a), participants must use one button to identify Black faces and negative words and another button to identify White faces and positive words. In the other condition (b), the positive and negative words are switched to be paired with the other race (Black/positive and White/negative). Average response times are faster when Black is paired with negative words and White is paired with positive words (c). Is this a sign of hidden prejudice?

The second block of trials rearranges the associations. This time subjects press one button if they see a White face or a negative word, and a different button if they see a Black face or a positive word. Thus, in this round, the buttons are associating the stimuli in stereotype-inconsistent ways. In this situation, people take an average of 1015 milliseconds to press the correct button, more than one-fifth of a second longer than in round 1. (To control for any possible effects of going first vs. going second, the order in which a person goes through these tasks is usually counterbalanced across subjects, with some going in the order presented here, and others in the reverse order.)

Why does it take longer to respond when there is a Black/positive button than when there is a Black/negative button? The researchers reasoned that racial schemas associate more negativity with Blacks than with Whites. Because schemas guide information processing, they facilitate the processing of information that is schema-consistent. Thus, it is easier for a person to make snap judgments to always press one button for either Black or negative stimuli. But schema-inconsistent information is more difficult to process. Thus, having two different buttons for Black and for negative means that a person has to override their automatic, implicit association between Black and negative, in order to choose the correct response. The size of the reaction time discrepancy between these two rounds is

believed to be a direct measure of the strength of people's implicitly held negative beliefs or stereotypic associations with Blacks.

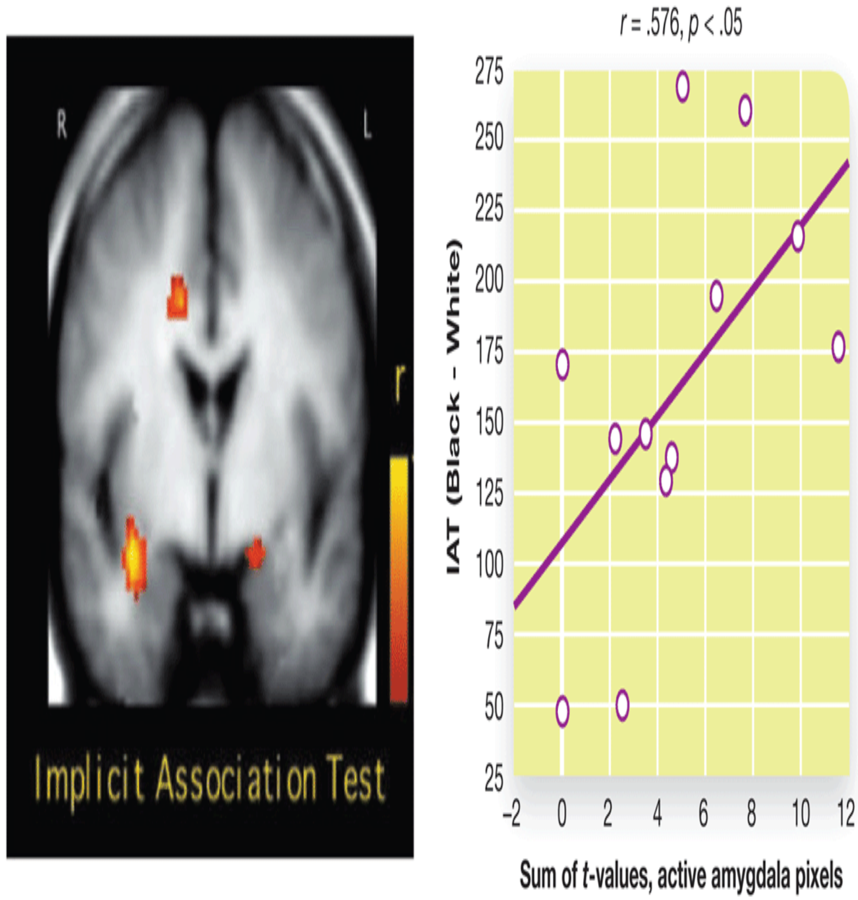
The IAT was a major breakthrough, suddenly allowing us to directly measure a person's implicit biases. Researchers quickly started to develop ways of measuring all sorts of implicit things—implicit attitudes, self-esteem, feelings of connection to nature, and prejudice toward many groups.

Can we critically evaluate this evidence?

Although the data gathered with this instrument show reliable results, some psychologists have questioned the test's validity: Is the IAT really a measure of prejudice? Or is it possible that the IAT is merely measuring the extent to which people have been exposed to negative stereotypes, but have not necessarily developed prejudices? After all, simply knowing about a stereotype does not mean an individual believes it, uses it to judge people, or engages in discriminatory behaviour.

Studies by Elizabeth Phelps and her colleagues (2000) suggest that the IAT reflects a person's emotional reactions to outgroup members. In her studies, White participants were shown pictures of Black and White faces while having their brains scanned using fMRI. The amount of activity detected in the amygdala (a brain area related to fear responses) when looking at Black faces was positively correlated with participants' IAT measures of implicit prejudice (see Figure 13.6). This suggests that the IAT is measuring something real enough to be reflected in neural activity in areas related to fear and emotional processing.

Figure 13.6 Implicit Associations and the Brain



Researchers displayed photographs of Black and White faces. In White participants, Black faces elicited more activity than White faces in the amygdala, an emotion centre of the brain. This activity was positively correlated with participants' responses on the IAT.

Source: Phelps, E. A., O'Connor, K. J., Cunningham, W. A., Funayama, S., Gatenby, J. C., . . . Banaji, M. R. (2000). Performance on indirect measures of race evaluation predicts amygdala activation. *Journal of Cognitive Neuroscience 12*, pp. 729–738. © 2000 by the Massachusetts Institute of Technology.

Why is this relevant?

The development of the IAT has fostered a great deal of research and has been applied to at least a dozen forms of stereotyping, including stereotypes of social classes (Rudman et al., 2002), sexual orientation (Banse et al., 2001), and even fraternity and sorority members (Wells & Corts, 2008). The results of all these

tests illustrate that implicit prejudice seems to be more prevalent than people are willing to express in explicit tests (Nosek et al., 2002). The IAT is also being applied to clinical settings. For example, one research group developed an IAT that measures attitudes about alcohol use. This instrument can successfully predict how much alcohol someone is likely to consume, even when explicit measures fail to do so (Ostafin et al., 2008). To the extent that this methodology is valid, it is extremely valuable, giving us a window into people's private minds.

Improving Intergroup Relations

Listen to the Audio

We are left with an immense practical challenge: How can we overcome the implicit processes we have examined in this module and work toward eliminating harmful stereotypes, prejudices, and discrimination from our society? Unfortunately, there are no easy answers. But there are some promising possibilities.

Kerry Kawakami at York University has spent more than a decade researching how to overcome implicit stereotyping and prejudice. Research in her lab has shown that people's implicit networks can be "reprogrammed" through practice. For example, we know that many people automatically make dispositional attributions for others' negative behaviours (*the guy driving the pickup is an idiot!)*, and this is especially true for other groups (*like all teenage boys!)*. But people can be trained to resist the implicit bias to make situational attributions (*maybe the kid swerved to hit something in the road*). This helps to prevent people from thinking of others in stereotypic ways (Stewart et al., 2010). In another study, Kawakami and her colleagues used a computer task to teach people to make different associations with a stereotyped group. Subjects were presented with photographs of Blacks and Whites, coupled with either stereotypic or non-stereotypic traits, and were instructed to respond "NO" to stereotypic pairings and "YES" to non-stereotypic pairings. After extensive training involving many such trials, subjects no longer activated negative racial stereotypes, even at the implicit level (Kawakami et al., 2000). This suggests that, over time, it may be possible for people to

*un*learn the stereotypes that history has provided us with. However, there is a huge gap between the kind of intensive training that Kawakami's participants experienced in the lab and the real-world experience of individuals who are bombarded with both stereotypic and non-stereotypic messages on a daily basis. Nevertheless, these results suggest that it is at least possible for people to "reprogram" themselves.

One of the most well-supported ideas in all of social psychology is the **contact hypothesis**, *which predicts that social contact between members of different groups is extremely important to overcoming prejudice* (Allport, 1954; Pettigrew & Tropp, 2006), especially if that contact occurs in settings in which the groups have equal status and power and, ideally, in which group members are cooperating on tasks or pursuing common goals (Sherif, 1961). Negative stereotypes and the attendant prejudices thrive under conditions of ignorance, whereas allowing people to get to know members of outgroups, to work together to pursue common goals, to come to appreciate their membership in common groups or as part of the same ingroup (e.g., we're both Blue Jays fans, Canadians, or members of the human species; Gaertner & Dovidio, 2000), and to develop friendships with members of outgroups (Pettigrew, 1997, 1998) are all different ways in which contact helps to overcome prejudice. In fact, contact between members of different groups not only helps to combat their own prejudices, but that of their friends as well. Simply knowing that someone is friends with an outgroup member serves to decrease the prejudice of that person's friends (Wright et al., 1997).

Coming to see our fellow human beings as all part of the same human family is an opportunity that recent advances in technology (the internet, space exploration), economics (globalization), and, ironically, global problems (climate change, nuclear proliferation) have made available to all of us. This global perspective shift may, we hope, help us to overcome our age-old group prejudices. Astronauts who travel into space and look

back on this one little planet that we inhabit often report that the experience profoundly affects them.

> The first day or so we all pointed to our countries. The third or fourth day we were pointing to our continents. By the fifth day, we were aware of only one Earth.

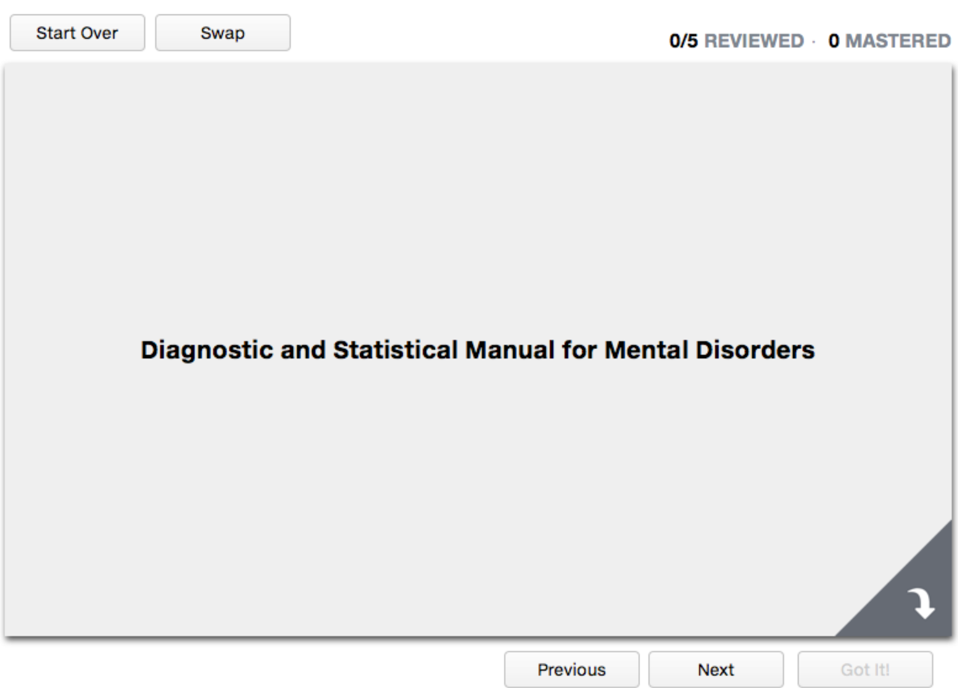
Source: I Congress of the Association of Space Explorers Cernay, France, October 2–6, 1985. Quote of Sultan bin Salman Al-Saud,

Module 13.2 Summary

Listen to the Audio

13.2a Know . . . the key terminology associated with social cognition.

Review Module 13.2



13.2b Understand . . . how we form first impressions and how these impressions influence us.

We quickly form impressions, even when only thin slices of behaviour are available to us. These impressions can be surprisingly accurate, but they

can also affect our behaviour in ways that tend to confirm our initial impressions; this is the phenomenon of self-fulfilling prophecies.

13.2c Apply . . . your knowledge of attributions and biases to better understand how you tend to perceive yourself and others.

It is important to understand ourselves and those who we interact with on a regular basis. The research makes it clear that we often rely on first impressions and thin slices to understand people, and sometimes we succumb to biases.

Apply Activity

Complete the following exercise—and be honest—to find out more about your own tendencies.

Review Description of Self and Others, Part 1

First, consider your own personality and behaviors. For each of these 10 items, either select the personality trait that best describes your behavior or select "Depends on the situation" if that is more accurate.

1. The personality trait that best describes me is:

- ◯ Serious
- ◯ Joyful
- ◯ Depends on the situation

2. The personality trait that best describes me is:

- ◯ High-energy
- ◯ Low-key
- ◯ Depends on the situation

Previous | Next

Review Description of Self and Others, Part 2

Next, think about a classmate. For each of these 10 items, either select the personality trait that best describes your classmate's behavior or select "Depends on the situation."

1. The personality trait that best describes my classmate's behavior is:

- ◯ Serious
- ◯ Joyful
- ◯ Depends on the situation

2. The personality trait that best describes my classmate's behavior is:

- ◯ High-energy
- ◯ Low-key
- ◯ Depends on the situation

Previous Next

Source: Based on Nisbett, R. E., Caputo, C., Leganta, P., & Marecek, J. (1973). Behavior as seen by an actor and as seen by the observer. Journal of Personality and Social Psychology, 27(2), 154-164

Source: Adapted from Nisbett et al., (1973). Behaviour as seen by the actor and as seen by the observer. *Journal of Personality and Social Psychology, 27(2), 154-164.*

13.2d Analyze . . . whether people who commit discriminatory acts are explicitly prejudiced.

It is certainly possible for people to commit discriminatory acts without being prejudiced. Regardless of prejudice, stereotypes are absorbed from the larger culture, and these can function as interpersonal schemas that can guide how we see things and how we implicitly process information. This can cause us to behave in a discriminatory fashion without us intending to, such as being more likely to assume an ambiguous object is a gun if held by a Black man, compared to when it is held by a White man.

Module 13.3 Attitudes, Behaviour, and Effective Communication

Listen to the Audio

ZUMA Press, Inc./Alamy Stock Photo.

Learning Objectives

13.3a Know . . . the key terminology in research on attitudes, behaviour, and effective communication.

13.3b Understand . . . how behaviours influence attitudes in terms of cognitive dissonance theory.

13.3c Apply . . . your knowledge of cognitive dissonance to see how well your beliefs match your behaviours.

13.3d Analyze . . . the difficulties communicators face in trying to convince the public to take action on important social and political issues.

Bill McKibben is a man on a mission. He wants to save the planet. Actually, to be more accurate, he wants to save the kind of planet that humans can live on. But unlike many people with such ambitious dreams, Bill has a few very important factors on his side.

First, he knows what he is talking about when it comes to saving the planet, having published many books and articles on the topic over the past few decades. Second, he has the full weight of the scientific community behind his cause, which agrees that the human species is heading rapidly for catastrophe as we push global warming higher and higher. And third, he has a global organization, 350.org, spanning almost every country on Earth, with hundreds of thousands of members. He also has some significant victories under his belt, from organizing the most widespread days of political activism in history to raising unprecedented opposition to key government decisions. Although he has won some of these battles, he has not always been successful. That was the case in his fight against TriCanada Corporations's Keystone XL pipeline to take oil from Alberta's oilsands and transport it across the United States; this project received government approval despite his efforts.

For Bill McKibben, and for the human species more generally, to succeed in the fight against the climate crisis, there are some big barriers to overcome. Psychology provides a great deal of insight into how to rise to such a societal challenge. Any social problem is, at some level, a

problem of human behaviour, and finding solutions therefore inevitably involves changing human behaviour.

According to the American Psychological Association's official task force on climate change, "Addressing climate change is arguably one of the most pressing tasks facing this planet and its inhabitants" (American Psychological Association, 2010, p. 6). The task force was comprised of a carefully chosen group of highly regarded senior scientists, including the University of Victoria's Robert Gifford. Climate change, like many other social and political issues, is fundamentally a problem of psychology. After all, it is human decision making and behaviour that lead to its effects. This module examines how psychologists study changes in attitudes and behaviours—not just in regard to climate change but in all kinds of beliefs and behaviours.

Changing People's Behaviour

Listen to the Audio

There are four common approaches to encouraging positive behaviour change and reducing negative behaviours:

- Technological—making desired behaviours easier to accomplish and undesired behaviours more difficult
- Legal—creating policies and laws to encourage or reward positive behaviours while discouraging or punishing negative behaviours
- Economic—providing financial incentives and penalties, generally through taxes and pricing
- Social—using information and communication to raise awareness, educate, and illustrate positive and negative outcomes of relevant behaviours

Although each of these approaches obviously can have an impact on public behaviour, they can almost always be combined in a campaign for behaviour change. To return to the example of climate change, there are clear examples of how organizations and governments have encouraged ecologically responsible behaviour.

- Technology—such as cleaner fuels, improved solar and wind power, and more energy- efficient appliances—allows consumers to choose greener options.
- Legal actions include regulations on the amount of waste corporations can produce and how toxic chemicals must be handled.

- Governments provide economic incentives through tax breaks for pro-environmental action, and fines for violating legal regulations.
- Advertising campaigns can spread factual information while social media campaigns help establish social norms.

As you can see, none of these approaches rule out the possibility of other approaches being implemented. In fact, they are often stronger together.

Learning how to communicate effectively in order to influence attitudes and behaviour has been a major focus of psychology for most of its history, and we have learned a great deal about how to do so.

Persuasion: Changing Attitudes through Communication

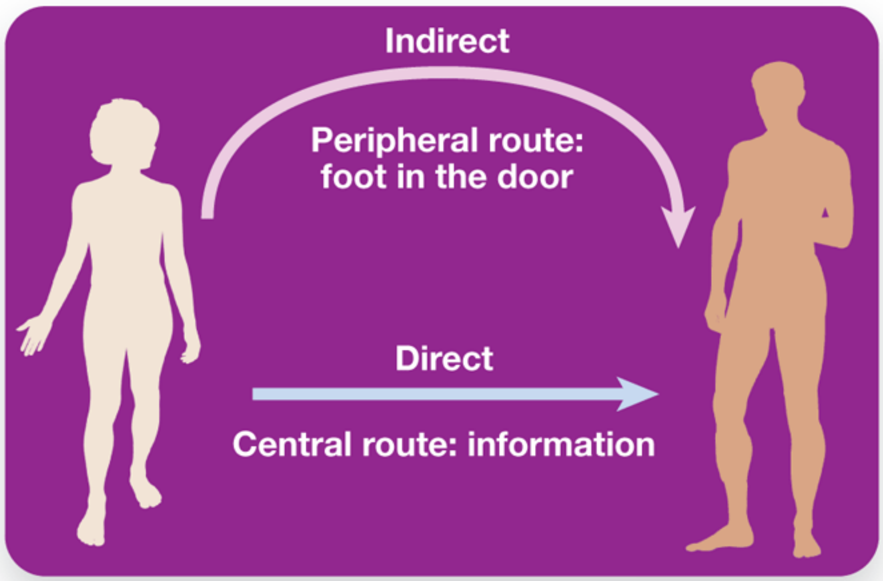
Listen to the Audio

Social psychologists have discovered many important principles underlying effective communication, and have shaped these into tools for influencing all sorts of behaviours, from advertising meant to get us to buy more stuff to pro-social causes such as getting us to donate blood. The gist of these principles is explained by the **elaboration likelihood model (ELM)**, a *dual-process model of persuasion that predicts whether factual information or other types of information will be most influential*. You'll recall from Module 13.2 that dual process models distinguish between automatic, nonconscious thoughts versus more deliberate thinking. According to the ELM, which process a person uses is the product of two factors: motivation and time. When audiences have interest in the topic, they are more motivated to think rationally about it. When audiences have time to make a decision, they will also be more rational. However, if they lack either of these—motivation or time—then they almost certainly will react more intuitively. Knowing this, psychologists can appeal to people through two general routes: *the central route* and *the peripheral route* (Cacioppo et al., 1986).

The **central route to persuasion** is all about substance; *it focuses on facts, logic, and the content of a message in order to persuade*. If the message is sufficiently compelling, people will be convinced, internalizing the message as something they believe in (see Figure 13.7). As a result, attitude or belief change that occurs through the central route tends to be

strong and long-lasting. However, as you may have surmised, this is a rational process that requires the audience to have both motivation and time.

Figure 13.7 Central and Peripheral Routes to Persuasion



There are two ways that communications can persuade people. In the central route people are persuaded by the content of a message, while in the peripheral route they are influenced by the way the content is presented, the *style* over the *substance*.

However, much of the time, people are not going to pay sufficient attention to the content of a message. In this case, you would be wise to take the **peripheral route to persuasion**, which *focuses on features of the issue or presentation that are not factual*. Seemingly irrelevant factors such as the attractiveness of the person delivering the information, or the number of arguments made (regardless of the quality of those arguments), can create a quick, positive impression. Lacking the time

and/or motivation to think about it, that first impression can be largely—even solely—responsible for persuading an individual.

In so many cases, the central route is preferable because it is factual. You would hope your physician prescribes a medication for you based on data from randomized, controlled medical experiments, not the fact that the pharmaceutical salesperson for one brand was really cute. It is also often the case that peripheral tools can be quite dangerous; they can make even very weak arguments persuasive because few people are thinking critically about them.

Using the Central Route Effectively

Listen to the Audio

In order to use the central route effectively, you need to be confident that you have the facts on your side and that they are presented at a level the audience understands. Also, recall that, according to the ELM, people are only likely to take advantage of the central route if they are motivated and have the time and opportunity to think.With these factors in mind, this section of the module will examine some key strategies for maximizing the central route.

Make It Personal

Listen to the Audio

Making a message self-relevant is crucially important to motivating people. Consider one striking study from the early 1980s (Gregory et al., 1982), a time when cable television (CATV) was still making its way into the North American viewing market. Researchers compared two very similar persuasive appeals, which were presented to two samples of homeowners to try to convince them to subscribe to CATV. The first was an information-only condition in which homeowners heard this appeal:

> CATV will provide a broader entertainment and information service to its subscribers. Used properly, a person can plan in advance to enjoy events offered. Instead of spending money on the babysitter and gas, and putting up with the hassles of going out, more time can be spent at home with family, alone, or with friends.

The second group was an imagination condition in which homeowners received this appeal:

> Take a moment and imagine how CATV will provide you with a broader entertainment and information service. When you use it properly, you will be able to plan in advance which of the events offered you wish to enjoy. Take a moment and think of how, instead of spending money on the babysitter and gas, and then having to put up with the hassles of going out, you will be able to spend your time at home, with your family, alone, or with your friends.

As you can see, the two appeals are almost identical, providing the exact same arguments; from the perspective of the central route, they should have exactly the same impact. However, that's not what happened: Only 19.5% of the people who received the information-only appeal signed up for CATV, whereas a whopping 47% subscribed when they were simply

told to imagine themselves in the scenario! Imagine the profit difference between selling your product to one in five or one in two people. This is the power of making things personal.

This power has been explained by **construal-level theory** (Trope & Liberman, 2010), *which describes how information affects us differently depending on our psychological distance from the information*. Information that is specific, personal, and described in terms of concrete details feels more personal, or closer to us, whereas information that is more general, impersonal, and described in more abstract terms feels less personal, or more distant. Importantly, psychological distance depends not only on geography (people or places that are farther away are less personal), but temporal factors (distant future or past times feel less personal), social factors (people or groups that are further removed from your identity are less personal), how abstract the information is (abstractions are less personal than things that are specific), and even the level of certainty a person feels about an outcome (outcomes that are less certain are less personal).

Communicators should be able to make their messages feel more personally relevant to the audience by working with these factors, bringing the message close to home in time and space, showing how it affects the audience themselves or their social groups, and making consequences or outcomes as certain as possible. Think about some of the issues we've addressed at various points in the text. For example, many people fear the measles vaccine despite the mounds of evidence from research and decades of clinical data that speak to the contrary. It is likely that construal-level effects are happening. For a parent, you can't get much more psychologically close to anything than you do your children—that opens up the opportunity to be swayed by non-factual events such as fear of autism and the need to feel control over a situation.

Working the Scientific Literacy Model

The Identifiable Victim Effect

Listen to the Audio

We are often most motivated by issues when they have a clear message and strong images. The issue of school safety in the United States is influenced by stories such as the horrendous shooting death of 20 children and six adults in Sandy Hook Elementary School in 2012. Following the news coverage, people called for action, either for gun control laws or for tightening security. The crisis facing refugees fleeing war-torn Syria gained international attention when heart-breaking photographs showed the body of three-year-old Alan Kurdi. Racial tensions in the United States, which led to the Black Lives Matter movement, are all too often linked with violence, such as the police killing of Michael Brown in Ferguson, Missouri, in 2014. These are all upsetting social issues filled with real human tragedy. But some causes seem to reach far fewer people, and that certainly is the case for climate change.

What do we know about communicating about tragedy and danger?

Communicators need to understand how persuasion works in order to get people to respond to tragedies and threats. ELM tells us that we have to understand the audience's motivation to think about the issue and their opportunities to do so. Although we may not always be able to control these, it is certainly possible to

address motivation by decreasing psychological distance. In terms of climate change, communicators can talk about the effects scientists observe now, but these are often in other places; they talk about what will happen if behaviour doesn't change, but that is often in the distant future. Therefore, communications have often felt "distant" to many people, particularly those who do not rely on a dependable climate in their day-to-day lives. In fact, the term *climate change* itself implies something global and abstract. When people do think of specific others who may suffer due to climate change, they tend to think of others in the distant future or in distant parts of the world (Leiserowitz et al., 2010; Lorenzoni & Pidgeon, 2006).

How can science explain the identifiable victim effect?

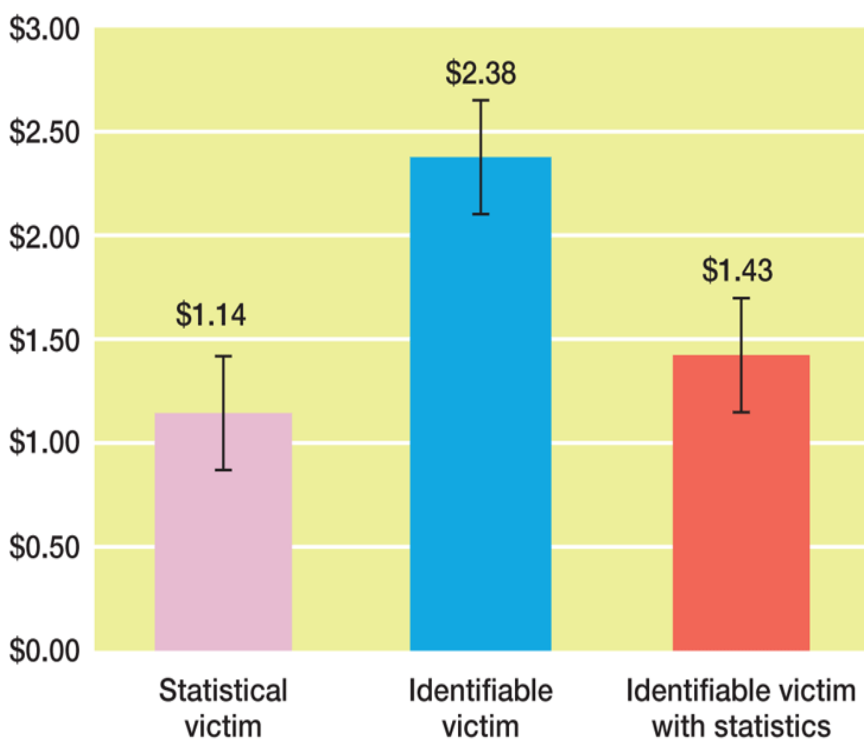
Many experiments have shown that information about tragedies and threats has much more impact if it focuses on specific details and concrete events than if it relies upon more abstract, statistical information. For example, the **identifiable victim effect** *describes how people are more powerfully moved to action by the story of a single suffering person than by information about a whole group of people*.

In one study (Small et al., 2007), researchers gave subjects a chance to donate up to $5 of their earnings from participating in the study to an organization, Save the Children, based on information provided in one of three conditions. In the *identifiable victim condition*, participants read about Rokia, a seven-year-old girl from Mali, who was desperately poor and facing severe hunger and possibly starvation. In the *statistical victims condition*, participants read about food shortages and rainfall deficits affecting more than 20 million people in four countries in Africa. In the third, *combined condition*, both types of

information were provided; participants read about Rokia and then were also given statistical information about mass suffering in African countries.

The identifiable victim effect was clearly demonstrated. People who read about Rokia gave significantly more ($2.38) than people who read general statistical information ($1.14). Clearly, Rokia tugs on the heart-strings more than abstract numbers do (see Figure 13.8). It is worth pointing out how strictly illogical this is; if we were rational processors of information, we would respond more strongly to statistics, which is essentially many, many Rokia-like stories combined with each other, than to one single story of Rokia, which is, after all, "just an anecdote."

Figure 13.8 The Identifiable Victim Effect



Participants were willing to donate more money after reading about a specific victim of starvation than they were after reading statistics about widespread starvation. Surprisingly, combining

the story of a specific victim *and* general statistics led to levels of donations similar to the statistics-only condition.

Source: Republished with permission of Elsevier Science, Inc., from Small, D. A., Loewenstein, G., & Slovic, P. (2007). Sympathy and callousness: The impact of deliberative thought on donations to identifiable and statistical victims, *Organizational Behavior and Human Decision Processes*, *102*, 143–153. Fig. 3, p.149. Permission conveyed through Copyright Clearance Center, Inc.

One interesting twist in this study was that participants who were given information about Rokia combined with the statistics donated only $1.43, which was statistically no different than what participants gave after being presented with the statistics alone, and was certainly much less than participants gave after only hearing Rokia's story. This study suggests that trying to simultaneously appeal to the head *and* the heart might not always work! This has enormous implications for anyone who wants to communicate to others; you have to very carefully consider the balance of your factual information and technical details with your stories, jokes, images, and metaphors. Clearly, it's not as simple as "have solid facts and tell a good story," because sometimes combining the two approaches doesn't work.

Earlier in the module, we mentioned that abstract information is experienced as more *psychologically distant* than concrete, specific information. But this doesn't go far enough to help us understand the findings in this Rokia study. There are two key results to explain. First, why does Rokia's individual story have more impact than millions of Rokia stories presented in the form of statistical information? Second, why does combining Rokia's story with statistics actually make it *less* likely for people to act?

To understand these findings, psychologists rely upon dual-process models (see Module 13.2) of information processing (Stanovich & West, 2000). The **experiential system** (Epstein, 1994), *operates more implicitly, quickly, and intuitively and is*

predominantly emotional; this system responds strongly to personal experiences, images, stories, and other people's emotions. In contrast, the **analytic system** *operates more at the explicit level of consciousness, is slower and more methodical, and uses logic and discursive thinking (i.e., reasoning using language) to try to understand reality*. The analytic system specializes in *understanding*, whereas the experiential system specializes in *intuition and feeling*. With these systems in mind, you can begin to see why Rokia's story would be so powerful. Rokia's story speaks to the experiential system, thereby triggering emotional responses, such as empathy, that would motivate people to give to charity. The abstract statistics, however, speak to the analytic system, the head rather than the heart. Less emotional impact leads to less motivational strength (Barrett & Salovey, 2002; Forgas, 2000). Without emotions, information about the suffering of millions of people becomes "just a number," an abstraction that is difficult to *feel*.

Can we critically evaluate this evidence?

Taken by itself, this single study cannot tell us whether individual stories are more motivating. Although one might expect that the most effective approach would simply be to appeal to both systems, it seems that in some situations at least, involving the analytic system at all can backfire. It is as though the analytic system inhibits or shuts down the experiential system, putting people in more of a cold, analytic frame of mind, so that they have little access to their emotional responses. This may be why the condition that included both Rokia and the statistics was no more motivating than the statistics alone. The cold, analytic way of thinking that was activated by the statistics made Rokia's emotional story have less impact than it had on its own (Loewenstein et al., 2001; Slovic et al., 2002). Nobel prize–

winning biochemist Albert Szent Gyorgi sums this idea up nicely when he talks about the difficulties trying to wrap your head around the consequences of nuclear war. "I am deeply moved if I see one man suffering and would risk my life for him. Then I talk impersonally about the possible pulverization of our big cities, with a hundred million dead. I am unable to multiply one man's suffering by a hundred million" (Slovic, 2007).

Why is this relevant?

Obviously, we cannot dispense with talking about statistical, abstract information if we are to communicate with each other about what is happening in the world. It therefore becomes extremely important to understand how the experiential and analytic systems can work together, and how to make the best use of them in crafting effective communication strategies.

This research is highly relevant to the challenge of motivating people to take action on major societal issues such as climate change (e.g., Slovic, 2007). The basic principle for communicating in a way that motivates behaviour change is to personally engage the person to reduce the psychological distance of the information. There are many ways to do this, including framing information in a personal way, describing abstract information as personal experiences, focusing on the near future rather than the distant future, emphasizing specific actions that will make a difference, and using social media strategies so that information comes from friends rather than from strangers.

Nevertheless, despite all the tools that we have to communicate and influence behaviour more effectively, countless questions remain concerning how to make the best use of these tools. These questions will have to be answered over and over again, as

we seek (and hopefully find!) solutions to the challenges we face, from our personal lives to issues of global scale like climate change. One of the biggest challenges that must be overcome when communicating about any issue is to understand how to connect the issue to the *values* of the people receiving the message.

Value Appeals

Listen to the Audio

As any good marketer knows, audiences are much more likely to listen to a message that is framed in such a way that it seems relevant to their values. Interestingly, pro-environmental behaviours have often been framed in ways that go *against* people's self-interest, involving trade-offs between the economy *or* the environment, jobs *or* trees, comfort and convenience *or* personal sacrifice (Schultz & Zelezny, 2003). And as noble as it might be to sit in the dark, shivering through the winter, and eating only locally grown root vegetables while having two-minute showers once a week, these are unlikely to be the next hot behaviour trends.

From a strategic point of view, appealing to your audience's values generally enhances the impact of messages; however, as we'll discuss at the end of this module, appealing to your audience's existing values may, in some cases, be detrimental to your cause.

Preaching or Flip-Flopping? One-Sided vs. Two-Sided Messages

Listen to the Audio

One potential downside to taking a straightforward values approach is that you might sound "preachy." People may feel like you are shoving your values onto them, and therefore reject your arguments. On the other hand, if you don't make your own position clear and advocate clearly for your values, people may think you are a "flip flopper" who doesn't stand for anything in particular, or they may just get confused while you describe all aspects of an argument, and stop paying attention.

In short, is it better to give a one-sided message, arguing for a specific position, or a two-sided appeal that acknowledges different perspectives? You might think that the one-sided message is strongest, because it's least likely to raise doubts in the audience's mind, but research suggests otherwise (O'Keefe, 1999). It is actually more persuasive if you acknowledge opposing arguments than if you just preach from your own soap-box, unless your audience is unlikely to ever hear information that counters your message.

By giving a two-sided message, you make it more likely that your audience will see you as trustworthy and honest. But you gain in another, sneakier way as well. By bringing up, and shooting down, weak opposing arguments—or even completely fabricated arguments—you help your audience resist those arguments in the future. In politics, this is often called a "straw man," but the social psychological term is **attitude**

inoculation, *a strategy for strengthening attitudes and making them more resistant to change by first exposing people to a weak counter-argument and then refuting that argument* (Compton & Pfau, 2005; McGuire, 1961). This strategy operates in a similar way to how the flu shot protects you from the flu. When you get injected with a weakened version of the flu virus, your immune system has a chance to respond, building up the antibodies it will need when the real flu comes along.

Clarity and Complexity in the Central Route

Listen to the Audio

Another key factor that can easily derail communication is the message's complexity. If your arguments are overly technical or convoluted or use specialized language, these can activate a chain reaction. Confusion and cognitive challenge triggers negative emotion, which triggers a drop in motivation and an increase in time required for comprehension, and eventually an individual's shift toward the peripheral route. This is a big challenge for communicating about technical topics like scientific theories, philosophical concepts, and the like. Strangely, experts are often terrible at communicating their knowledge, tending to forget that their audience may not understand the technical language they use and the subtleties of what they are saying. Chip and Dan Heath (2007) call this the "curse of knowledge." Anybody who has ever listened to an expert being interviewed on the news has likely experienced this phenomenon. The expert may find the conversation fascinating and rife with meaning, but to the audience it may sound like a monotonous drone.

The curse of knowledge was shown in an innovative experiment in which subjects were assigned to be "tappers" or "listeners" (Newton, 1991). The tappers were asked to tap the rhythm to a selection of extremely well-known songs, like "Happy Birthday," while the listeners tried to guess the songs. To the tappers, the songs were totally obvious; when they tapped out "Happy Birthday," they would hear the words and the tune in their heads and it seemed pretty likely that the listeners would be able to guess the song; in fact, they estimated that listeners would guess about 50% of

the songs. To the listeners, however, the vague "tap-tap-TAP-tap TAP TAP" didn't amount to much. They guessed the correct songs a mere 2.5% of the time!

This study illustrates how people with knowledge tend to overestimate the amount of knowledge their audience will have. When you are communicating, remember to keep your audience's perspective in mind and fight the urge to use impressively long words, acronyms, and technical lingo. Saying less, and saying it in less complex ways, is often saying more.

Using the Peripheral Route Effectively

Listen to the Audio

To be an effective communicator, you can't ignore the peripheral route. Half a century of social psychology research has identified many powerful factors of influence—far more than can be represented here. You might even recognize some of these, because they have undoubtedly been used against you many times, from corporations trying to sell you products to people trying to get you to do them a favour.

Authority

Listen to the Audio

The use of experts and authority figures to deliver a message can often enhance the impact of the message (Cialdini, 2001). Authorities presumably should be reliable contributors through the central route, presenting facts and figures. But authorities can wield influence even outside of their area of expertise—clearly it's the status and not the experience that matters in those cases. Dressing the part is important as well; one amusing study from long ago showed that a man wearing a suit who jaywalks against a red light will be followed by 3.5 times as many people as the same man wearing casual clothes (Lefkowitz et al., 1955).

Uniforms influence behaviour by signalling authority and expertise, even if we know we're only looking at an actor in a commercial.

Thomas Andreas/Alamy Stock Photo

Liking

Listen to the Audio

We believe people we like. Communicators who connect with their audience get their message across more effectively (Cialdini, 2001). Liking can be influenced by numerous factors, including attractiveness. For example, in a study performed for the American Heart Association, attractive fundraisers generated almost twice as many donations (42% versus 23%) as their less-attractive counterparts (Reingen & Kernan, 1993). In the 1972 Canadian federal election, candidates who were rated as physically attractive got three times as many votes as unattractive ones (Efrain & Patterson, 1974); in fact, politically unpopular parties had substantially less attractive candidates, which may have been a big part of their party's lack of success at the polls! It is interesting to note that voters themselves insisted that their choices were not influenced by something as superficial as appearance. (In an interesting coincidence, the Prime Minister at that time was Pierre Elliott Trudeau—his son Justin has also received some attention because of his appearance.)

Thus, there are good reasons to be pleasant and appealing, and to look your best, at least from a persuasion perspective. Highlighting any similarities you may share with your audience, loosening up a little and speaking informally, appropriate use of humour, and even complimenting the audience, can all enhance your likability and increase the effectiveness of your communication.

Social Validation

Listen to the Audio

Because humans are such a social species, we use the behaviour of others as a guide to inform us of what we should do (e.g., social norms in Module 13.1 and conformity in Module 13.2). As an influence tactic, social validation can be incredibly powerful. Social validation is at work whenever you hear that a novel is a bestseller, a piece of music has topped the charts, there's a long line-up outside a nightclub, or "polls indicate" that a political candidate is popular.

One such example of social validation used in climate change communication occurred in the spring of 2013 when Bill McKibben's organization, 350.org, and several other organizations submitted a petition with one million signatures, urging President Obama not to allow the Keystone XL pipeline to transport oil from Canada's oilsands to the United States. Afterward, the fact that a million signatures were gathered became a major part of their organization's marketing messages. You can see how social validation becomes a major tool for communicators. Obviously, proponents of the pipeline would want to downplay these facts, whereas opponents of the pipeline would want to highlight them.

Although the information may be true and the intentions are good, these communications can easily backfire. In one study, a suicide intervention program in New Jersey told people about the high rates of teenage suicides. As a result, people who went through the program became *more* likely to think of suicide as a way out of their problems (Cialdini, 2001).

Reciprocity

Listen to the Audio

All cultures have a strong social norm that obligates people to repay to others what they have received. This strong social norm is used by influence specialists all the time, and it can be so sneaky we often don't realize it. Just think of the "free samples" offered by vendors, the "free trial workout" offered by health clubs, and even the "free personality assessments" offered by the Church of Scientology. Each makes you feel a debt or obligation. The principle of reciprocity is one reason why corporations donate to politicians' campaigns, and why pharmaceutical companies spend millions of dollars funding research; organizing conferences; and providing gifts, stationery, calendars, and even pens to doctors and family health clinics (Cialdini, 2001).

Reciprocity is often used in a two-step manner called the **door-in-the-face technique**, *which involves asking for something relatively big, then following with a request for something relatively small*. The logic is that once someone has scaled back their request, you are obligated to meet them partway. Professional negotiators will always start with a proposal they don't really expect to get; but they know that once they "give up" some of the things they want, the opposing side is obligated to do the same.

The door-in-the-face technique can be used to surprising effectiveness. In one well-known study by Bob Cialdini (Cialdini et al., 1975), people were approached on the street and asked whether they would be willing to volunteer to chaperone inmates from a juvenile detention centre for a day

trip to the zoo. When simply asked, 17% said yes. A second set of people were approached and submitted to a door-in-the-face manipulation. They were first asked if they would be willing to volunteer for two hours per week as a counsellor at the juvenile detention centre and make a commitment for two years. Everybody said no. But when they were subsequently asked whether they would merely agree to volunteer to chaperone inmates from the detention centre on a trip to the zoo for the day, an astonishing 50% said yes. This one-two punch is very effective, both because it makes the person feel obligated to say yes after you have "backed down," and because the second request doesn't *seem* as onerous when presented after the first, bigger request.

Consistency

Listen to the Audio

One of the most powerful influence techniques, especially for long-term behaviour change, is an old sales trick called the **foot-in-the-door technique**, *which involves making a simple request followed by a more substantial request*. To the travelling salesmen of days gone by, literally getting one's foot in the door meant that a homeowner could not shut you out. In social psychology, the idea is that once you get the person to agree to even a small request, it's harder for them to say no to a subsequent request (Burger, 1999; Cialdini, 2000).

The foot-in-the-door technique is also a sneaky strategy, because the initial request can be so small that virtually everyone would say yes to it. Nevertheless, it's powerful, because it makes use of a very strong motivation held by many people—the need for psychological consistency. We'll describe this in more detail, but just think of how people usually react to being called a hypocrite and you'll get a sense of the power of the need for consistency. So, the foot-in-the-door technique packs another powerful one-two punch—an initial request that's hard to refuse locks you in, and then you get cornered into agreeing to a much larger request (see Figure 13.9).

Figure 13.8 The Two-Step Persuasion Technique to Encourage Community Service

“Would you you sign a petition for this cause?” “Sure!”

The foot-in-the-door technique begins with a small request....

1 of 4 Previous Next

For example, if you are at the beach and you want to go swimming, how can you be sure nobody is going to steal your stuff? Just ask someone to watch your things for you! Simple as that. Although this may seem intuitive, you may be surprised by just how powerful this simple request can be. In one experiment, an experimenter posed as a person sunbathing on the beach, who at one point got up and asked whoever was close them to watch his things; everybody said yes. Then he left, and shortly afterwards, as you might expect, a mock-thief came along and attempted to steal the experimenter’s radio. An astonishing 95% of the people who agreed to watch his things attempted to interfere with the would-be thief, even to the point of chasing the thief down the beach! But in the control condition, when no one was asked, only 20% of people tried to stop the thief (Cialdini, 2001). Imagine that—an additional 75% of us will become heroic vigilantes just because some stranger casually asks us on a beach to watch his stuff.

Commitments can be extremely subtle, another reason they are sneaky. For example, one restaurant owner was able to reduce the rate of no-shows (people who reserve a table but then don't show up) from 30% all the way down to 10% by changing two words in the script that his employees used when scheduling reservations over the phone. In the old script, the receptionist would say, "Please call if you have to change your plans." In the revised script, she said "Would you please call if you have to change your plans?" Then she would wait for a couple of seconds until the person responded and said yes (Cialdini, 2001). Saying "yes" is an active commitment, and that tiny act was enough to get two-thirds of the no-shows to call first and cancel. Other studies have shown that written commitments ("sign here . . . ") are even more effective than verbal commitments, and commitments that can be made public are the most effective of all.

The Attitude–Behaviour Feedback Loop

Listen to the Audio

As we mentioned earlier, the reason the foot-in-the-door approach works so well is because people have a general need to be psychologically consistent—for their attitudes, beliefs, and behaviours to match up with each other. Much of the time, we maintain a feeling of consistency by letting our beliefs and attitudes guide our behaviours. We act in the way we think and feel is right. But the relationship between our actions and beliefs is not always this straightforward.

Cognitive Dissonance

Listen to the Audio

Groundbreaking work by Leon Festinger (1957) showed that we can also maintain a feeling of consistency by simply changing our beliefs to be consistent with our behaviour. Festinger (1957) proposed **cognitive dissonance theory**, describing that *when we hold inconsistent beliefs, this creates a kind of aversive inner tension, or "dissonance"; we are then motivated to reduce this tension in whatever way we can*, often by simply changing the beliefs that created the dissonance in the first place.

This sort of belief change was observed in a dramatic way by Festinger and two of his colleagues when they infiltrated a doomsday cult in the 1950s. December 21, 1954, was the date the world was supposed to end, according to the cult's leader, Marian Keech (not her real name). Keech told her followers that she was receiving messages from aliens who lived on the planet Clarion. The aliens had warned of an impending flood that would destroy life on Earth, but they promised to come in a spaceship and rescue Keech and her followers before the final cataclysm. If the members kept their faith, the aliens were supposed to contact them at midnight. The cult members were so convinced of impending doom that they gave away their possessions, quit their jobs, and prepared for the end.

Festinger and his colleagues, not being big believers in alien messages about the end of the world, wondered what would happen when the prophecy failed to come true. So, on December 20, the cult members,

including Festinger and his colleagues, gathered together and waited for the spaceship to arrive. Midnight came . . . and went. A few minutes after midnight the group decided the clocks were fast and any minute now, the aliens would be contacting them. Then an hour passed. And another. The group waited all night, increasingly confused, wondering what was going on.

Finally, at 4:45 AM, it was apparent the Clarions weren't coming to whisk them away. Keech had been wrong. The cult members had made fools out of themselves and ruined their lives. You might think that they would slink back to their normal lives, beg for their jobs back, and try to recover from the embarrassment. But no, the opposite happened. Keech suddenly got another message from the Clarions! They told her that because her little group had been so faithful, waiting all night for them to come, God had decided not to destroy Earth after all. They weren't fools; they were heroes! Convinced that they had saved the world, Keech and most of her followers (some decided this was ridiculous and ditched them at this point) became even more evangelical, contacting newspapers and media outlets, spreading the good word that the world had been saved (Festinger et al., 1956).

Festinger and Carlsmith (1959) tested cognitive dissonance theory by having subjects come to their lab and spend an hour engaged in a mind-numbing study that required them to perform menial, repetitive tasks. Afterwards, the subjects were told that in a different condition of the study, a research assistant meets subjects beforehand and gives them positive expectations of the study, telling them that it's a fun and interesting study. Unfortunately, the person called in sick that day, and so the subjects were asked if they would play the part of the research assistant for the next, incoming subject. All they had to do was sit in the waiting room, and when the next subject came in, chat with them and tell them the study was fun and interesting. Little did the unsuspecting

participants know that this was what the real study was about, getting them to tell a "little white lie" and then seeing how it affected their attitudes.

The subjects were also offered one of two amounts of payment if they agreed to go along with the deception. Some subjects were paid $1, and others were paid $20. After agreeing to play along and deceiving the person in the waiting room, subjects then filled out a few measures of their perceptions of the study. Lo and behold, after lying about the study, the subjects actually felt more positively toward it! But not all the subjects felt this way, only those who were paid $1. Why might this be?

The subjects who were paid $20 had more than enough justification for telling a little white lie—"I did it for the money." But getting paid $1 seems hardly worth it. These subjects were left in a state of uncomfortable dissonance, caught between the beliefs "deceiving people is wrong" and "I just lied to somebody for a measly $1." However, by changing their attitudes—"I didn't really lie; this study was actually pretty interesting!"—subjects were able to resolve their dissonance and feel good again.

Cognitive dissonance theory can help to explain many puzzling phenomena of everyday life. For example, why would perfectly sane young people crawl through ice water in their underwear while others stood around shouting at them, throwing snowballs, and even spanking them? In the winter of 2013, exactly such an event happened at Ryerson University, when aspiring frosh leaders went through a "hazing ritual." When it came to light, university administrators and even Ontario's premier were shocked and appalled, although no official action was taken except to express disapproval.

Students at Dalhousie University, in the same year, were not so lucky. Dalhousie suspended its entire women's hockey team in January, except

for the rookies, who also lost their season as a result of not having a team to play with. The previous September, the team had held a party at which the rookies were subjected to hazing, and when it came to light, the university administration reacted based on a "zero tolerance" policy.

But why does hazing occur? People have traditionally believed that submitting new group members to rituals that are embarrassing, humiliating, even painful and dangerous, helps to bond new members to the organization, deepening their commitment and their feelings of belonging. Cognitive dissonance theory suggests they are right. Being humiliated and embarrassed would be generally dissonant with the belief "I am a reasonable, self-respecting person." But after you have just publicly degraded yourself, it's not easy to feel that way. One way to reduce the dissonance (or discomfort) and reconcile your belief about what you just did with your belief that you are a reasonable, self-respecting person is to change one of your beliefs a little bit. For example, if you suffered in order to join a really exclusive group, then this makes sense. Of course you would suffer in order to join *that* group! And this is exactly what people seem to do; after initiation rituals, they enhance their perceptions that *this* is a group worth belonging to.

Interestingly, because cognitive dissonance is based on the need for self-consistency, it does not appear to work in quite the same way across cultures. In more collectivistic societies, for example, the need for self-consistency is not as strong, because it is more widely recognized that a person's "self" is more fluid, manifesting differently in different social situations. This is reflected in collectivists experiencing less dissonance after making choices. However, research conducted at the University of Waterloo has shown that people from collectivist cultures do experience dissonance after making difficult choices for their friends (Hoshino-Browne et al., 2005). It appears that the need for self-consistency still exists; it's just that the "self" is more interpersonal than personal.

Attitudes and Actions

Listen to the Audio

If attitudes influence behaviours, and behaviours influence attitudes, then you can see that the two are connected to each other in a circular fashion, with each affecting the other in a self-reinforcing cycle. Because each process affects the other, what happens in these causal loops is that initially small changes can grow into very large changes over time. For example, an initially small behaviour change can feed back to strengthen the person's attitude toward that behaviour, which leads to greater behaviour changes in the future.

The foot-in-the-door technique illustrates this point well, because the intial small behaviour may change the attitude enough to support a larger behaviour commitment. Unfortunately for anybody hoping to use the foot-in-the-door technique to change society in major ways, the strategy seems most effective for encouraging the adoption of similar behaviours (e.g., signing a petition for a cause today will make it more likely that you'll volunteer for that cause in the future), but it does not reliably spill over to a wider range of behaviours. Spillover is even less likely if there are clear, extrinsically motivating reasons for engaging in the behaviour, such as saving beer money. Just like Festinger's subjects didn't need to change their attitudes when they were paid $20 for lying, people whose primary reason for conserving energy is to save money are not likely to strengthen their pro-environmental attitudes more generally. After all, they just did it for the money.

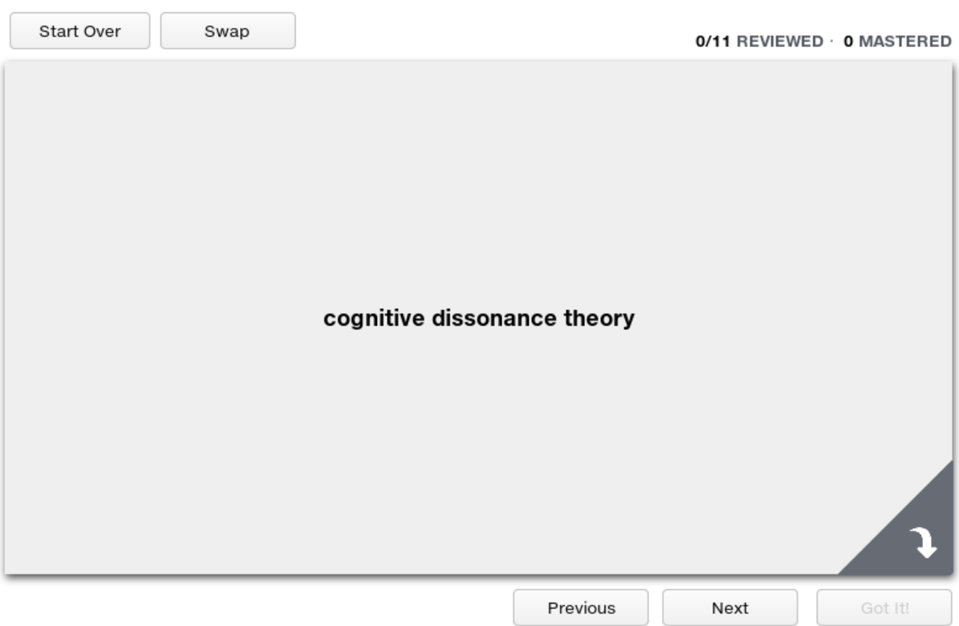
Nevertheless, as we have reviewed, psychologists have provided many insights and tools for communicating more effectively to change people's behaviour. Hopefully some of the readers of this text will use these tools to make the world a better—and more environmentally sustainable—place. It's up to *you*.

Module 13.3 Summary

Listen to the Audio

13.3a Know . . . the key terminology in research on attitudes, behaviour, and effective communication.

Review Module 13.3



13.3b Understand . . . how behaviours influence attitudes in terms of cognitive dissonance theory.

When people hold cognitions that conflict with each other, such as when they are aware that they have behaved in a way that runs counter to their

beliefs or attitudes, they experience an uncomfortable state of arousal known as cognitive dissonance. In order to reduce this dissonance, they need to change one of their conflicting cognitions, which often results in changing their attitudes in order to reflect the behaviour they just performed. In this way, behaviours and attitudes influence each other.

13.3c Apply . . . your knowledge of cognitive dissonance to see how well your beliefs match your behaviours.

Apply Activity

This attitudes scale was designed to illustrate how cognitive dissonance arises along with the cognitive reactions that seem to reduce the dissonance.

Table 13.2 The Attitudes Scale, Part A

Rate the following to indicate how strongly you agree or disagree with each statement.

1. World hunger is a serious problem that needs attention.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

2. Our country needs to address the growing number of homeless.

- Strongly Agree
- Moderately Agree
- Neither Agree nor Disagree
- Moderately Disagree
- Strongly Disagree

Previous Next

Table 13.2 The Attitudes Scale, Part B

Rate the following to indicate how often you perform the actions described in each statement.

1. Do you personally do anything to lessen world hunger (e.g., donate food or money, volunteer time, write your representative)?

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Often
- ◯ On a regular and frequent basis

2. Do you personally do anything to help the homeless?

- ◯ Never
- ◯ Rarely
- ◯ Sometimes
- ◯ Often
- ◯ On a regular and frequent basis

Previous Next

13.3d Analyze . . . the difficulties communicators face in trying to convince the public to take action on important social and political issues.

Communicators face some key challenges when developing persuasive messages. The example of climate change illustrates how the central route may not be effective when challenging normative behaviours, especially when it requires effort for the audience to change behaviour. Many issues, including climate change, are experienced as psychologically distant from the public, with consequences that people feel are generally going to be experienced by people in other parts of the world and by future generations. Added to that, climate change information is also highly technical complex, and abstract doesn't easily boil down to specific stories about "identifiable victims." For these

reasons, communicators often need to take the peripheral approach to persuasion.

Chapter 14
Health, Stress, and Coping

Listen to the Audio

14.1 Behaviour and Health

- Smoking
- Working the Scientific Literacy Model: Media Exposure and Smoking
- Obesity
- Psychosocial Influences on Health
- Module 14.1 Summary

14.2 Stress and Illness

- What Causes Stress?
- Physiology of Stress
- Working the Scientific Literacy Model: Hormones, Relationships, and Health
- Stress, Immunity, and Illness
- Module 14.2 Summary

14.3 Coping and Well-Being

- Coping
- Perceived Control

Working the Scientific Literacy Model: Compensatory Control and Health

Module 14.3 Summary

Module 14.1 Behaviour and Health

Listen to the Audio

Stock_wales/Alamy Stock Photo

Learning Objectives

14.1a Know . . . the key terminology related to health psychology.

14.1b Understand . . . how genetic and environmental factors influence obesity.

14.1c Apply . . . your beliefs about obesity to better understand sources of prejudice and stereotyping.

14.1d Analyze . . . whether media depictions of smoking affect smoking in adolescents.

Should consumers have to pay more for unhealthy or nonessential food items that contribute to obesity and other expensive health conditions? Taxes on these items are becoming increasingly common to offset the public health costs of a poor diet. For example, in March 2015, the city of Berkeley, California, instituted a "sugar tax" on sugary drinks such as colas in an effort to curb the increasing rates of diabetes and obesity. Sugary soft drinks contribute hundreds of calories to our daily diet without providing any nutrition, and do little to leave a person feeling nourished and satisfied. City officials assumed that taxing these beverages would reduce sugar intake and improve people's health. Preliminary data suggest that they were correct. Residents surveyed after the tax went into effect reported consuming 21% fewer sugar-sweetened beverages and 26% less cola (Falbe et al., 2016). Based on this initial success, it should come as no surprise that similar taxes were included in political campaigns in a number of municipalities during the November 2016 U.S. election. It seems a foregone conclusion that these taxes will soon appear in Canada as well. On the one hand, these fees may sound like the government interfering with our individual freedom to eat and drink what we like. On the other hand, there is a parallel precedent for sugar tax plans—namely, the massive taxes on cigarettes that serve to discourage smoking and help cover the costs of treating smoking-related illnesses. Plans such as sugar taxes tell us that

issues related to health and behaviour are becoming common topics of conversation in many areas of society.

To what degree do you believe your behaviour affects your health? Each day we make choices that shape our physical and mental health. We decide what to eat and what to avoid eating, whether to exercise or to relax on the couch. Some people choose to light up a cigarette whenever the chance arises. Others make a point of avoiding places where people are likely to smoke. The choices people make about their career paths similarly influence their health. Workplace stress levels for air traffic controllers are quite different from those experienced by small-town librarians. The numerous and complex connections between behaviour and health certainly have created an important niche for *health psychologists*. These researchers study both the positive and negative effects that humans' behaviour and decisions have on their health, survival, and well-being.

The desire to understand health puts psychologists in places you might not have expected. How about the intestines? Research on the seemingly endless supply of bacteria swirling around the gut shows that even intestinal bacteria might affect mental health. That can be shocking to many who assume that our digestive system and nervous system maintain a clear boundary. Nonetheless, the *microbiota*—the immense variety and number of microbes living in your lower digestive tract—directly influence nervous system functioning. You may have noticed that psychological disturbances (such as a very stressful event) may create digestive discomfort as well. This is most likely not a coincidence. About 90% of the serotonin circulating in our brain was manufactured by intestinal microbes (De Vadder et al., 2018), and, most antidepressant drugs are aimed at increasing serotonin in the brain.

As you can see, there are connections among behaviours, experiences, your body, and your health. The need for health psychology has become far more evident over the past century because we now know that most premature deaths are attributable to lifestyle factors. In the early 1900s, people in Canada were likely to die from influenza, pneumonia, tuberculosis, measles, and other contagious diseases. Advances in medicine have served to keep these conditions under much better control. Instead, people are now much more likely to die from tobacco use, alcohol use, obesity, and inactivity. In fact, more than half of all deaths in Canada in 2009 were caused by heart disease, cancer, stroke, and diabetes. Although genetics plays a role in these diseases, they have also been linked to unhealthy behaviours such as a poor diet and smoking (Statistics Canada, 2012a). Clearly, then, our physical and mental well-being are connected to the health decisions that we make.

Smoking

Listen to the Audio

One of the most widely studied health behaviours is tobacco use. Smoking cigarettes causes life-shortening health problems, including lung, mouth, and throat cancer; heart disease; and pulmonary diseases such as emphysema. Reports indicate that 21% of all deaths in Canada over the past decade were due to smoking-related illnesses (Jones et al., 2010). The life expectancy of the average smoker is between 7 and 14 years shorter than that of a non-smoker (Centers for Disease Control and Prevention [CDC], 2002; Streppel et al., 2007). This number depends upon how much, and for how long, a person smoked. Quitting by the age of 30 greatly reduces the likelihood that a person will die of smoking-related cancers, a statistic that is quite relevant to university students (Statistics Canada, 2012a)! The costs in lives and money attributable to smoking are massive, as shown in Table 14.1. Despite these starkly ominous figures, 19.9% of Canadian adults—22.3% of males and 17.5% of females—smoke cigarettes (Statistics Canada, 2012b). In other words, 5.8 million Canadians perform a behaviour that is quite likely to harm or even kill them. It should come as no surprise that such a statistic would interest psychologists.

Table 14.1 Health Costs of Tobacco Use

Table 14.1 Health Costs of Tobacco Use

• Tobacco use causes an estimated 5 million deaths worldwide each year.
• Cigarette smoking is the leading preventable cause of death in North America.
• One in five Canadian deaths is due to cigarette smoking.
• Close to 1000 Canadians die each year as a result of second-hand smoke.

Source: Based on CDC, 2009a; Rehm et al., 2006; Statistics Canada, 2012a.

Working the Scientific Literacy Model

Media Exposure and Smoking

Listen to the Audio

If smoking is so dangerous, why do people do it? Why don't they do something safer, like juggle scorpions? This is a perplexing question not only for psychologists, but also for many smokers. One reason may be the exposure young people have to other people who smoke: parents, friends, and even characters on television and in the movies.

What do we know about media influences on smoking?

There are many possible reasons why adolescents try smoking, including whether family members smoke, whether smoking is common in their culture, personality characteristics, and socioeconomic status. Adolescents may also begin smoking because they associate it with particular traits such as attractiveness, rebelliousness, and individualism. One factor that has received an increasing amount of attention from psychologists and healthcare providers is the role of the media. Specifically, does exposure to smoking in movies and entertainment lead teens to begin smoking? Actors in many popular television shows and movies such as Zendaya and Timothée Chalamet smoke. Indeed, smokers are often portrayed as sophisticated and self-assured, traits that many adolescents

hope to possess. In contrast, very few movies and magazines show someone with emphysema or lung cancer.

How can science help us analyze the effects of smoking in the movies?

To what extent do positive images of smoking in movies (and TV and magazines) contribute to adolescent smoking? This question has been addressed using a variety of methods. In one study, researchers conducted a random-digit-dialing survey of 6522 U.S. adolescents from all major geographic regions and socioeconomic groups (Sargent, 2005). The adolescents reported their age and indicated whether they smoked, and were asked to identify whether they had seen specific popular movies that featured smoking. The more exposure the adolescents had to movies that featured smoking, the more likely they were to have tried smoking. This relationship persisted even after the researchers controlled for important variables such as socioeconomic status, personality, and parental and peer influences on smoking (Heatherton & Sargent, 2009).

The effect of smoking scenes on behaviour has also been tested in the laboratory. In one study, 100 cigarette smokers between the ages of 18 and 25 watched either a 10-minute video with smoking scenes or a video that did not reference smoking. In the break that followed the video presentation, participants who saw smoking scenes were significantly more likely to light up a cigarette (Shmueli et al., 2010). This result is likely due to the fact that smoking cues such as images of smokers or of smoking paraphernalia (packages, lighters, etc.) elicit cravings in smokers (Balter et al., 2015).

It appears that how people identify with smokers may also influence their decision to smoke. An experimental study showed

that adolescents who had positive responses to a protagonist in a movie clip who smoked were much more likely to associate smoking with their own identities. This correlation was observed in both adolescents who already smoked and even those who did not smoke (Dal Cin et al., 2007).

Can we critically evaluate this evidence?

It is very difficult to establish that watching movie stars smoke cigarettes causes adolescents to take up smoking, even though the correlations might suggest that it does. When researchers tracked the amount of smoking featured in popular movies from 1990 to 2007, they found that as the incidence of smoking in movies rose, smoking among adolescents increased after a short period of time. Likewise, when smoking in movies decreased, a decline in adolescent smoking followed (Heatherton & Sargent, 2009). However, the problem with these correlations is that multiple explanations could be put forth for why they exist. Although the researchers would like to demonstrate that smoking in movies influences audience members, perhaps the truth is the other way around: People who are already willing to smoke might be more attracted to movies that feature smoking.

Why is this relevant?

Smoking by young people raises serious concerns about the health and well-being of those individuals who start smoking at such an early age. In addition, cigarette-related illness imposes a major societal burden in lost work productivity and rising healthcare costs. As the research shows, cigarette smoking in movies is just one of many influences on smoking behaviour. Of course, it may be one influence that could be easier to control than, say, peer pressure. With scientific research in hand, advocacy groups such as Smoke Free Movies, the (U.S.) National Association of Attorneys General, and Physicians for a Smoke-

Free Canada have a sound basis for arguing against smoking in movies—especially those that adolescents are likely to watch.

It appears that the work of these advocacy groups is paying off. After peaking in the middle of the past decade, the number of films including smoking is on the decline (Polansky, 2016). The number of "tobacco incidents" in PG-13 movies specifically targeted to teens increased from 565 in 2010 to 1155 in 2012; therefore, the curtain hasn't fallen on this issue.

Tobacco use in popular movies has raised serious concerns about its influence on smoking, particularly among teens. Although a cause–effect relationship between exposure to smoking in movies and actual smoking behaviour has not been established, public health officials have closely monitored the issue.

UPI Photo/Eduardo Sverdlin

Efforts to Prevent Smoking

Listen to the Audio

Given the health problems (to the smokers *and* to the people around them) and enormous healthcare costs associated with smoking, both healthcare workers and government officials recognize that more work has to be done to reduce smoking levels. Provincial and municipal laws are reducing the risks posed by second-hand smoke exposure by banning smoking in many public places—especially restaurants and public buildings. As mentioned at the beginning of the module, steep taxes applied to unhealthy products such as tobacco also act as a deterrent against their use. Not only does such a policy tend to reduce the number of smokers, but it also raises funds for healthcare and anti-smoking campaigns.

In the 1990s, several countries added written warnings to cigarette packages (e.g., "Smoking seriously harms you and others around you") in an attempt to reduce smoking rates. Unfortunately, these labels have had relatively little effect. However, in 2001, Canada became the first country to require companies to include graphic pictorial warnings on cigarette packages. These images included rotting teeth, black lungs, diseased hearts, and sick children; they were also paired with a verbal message. Researchers found that the image-based warnings were much more likely to be noticed by both smokers and non-smokers than were text-only messages (Fong et al., 2009; Hammond et al., 2003). They were also more useful than text-only messages in educating people about the risks

associated with smoking (Environics Research Group, 2007; Li & Yong, 2009).

Image-based warnings on cigarette packages are now used in over 30 countries (Hammond, 2011). Numerous studies have shown that these warnings are quite memorable and are having the desired effect. Over 40% of Canadian smokers indicated that the graphic warnings motivated them to quit (Hammond et al., 2007). And, although it is impossible to accurately state how many people avoided smoking because of the ads, surveys of Canadian adolescents suggest that these warning labels discourage teens from taking up smoking (Environics Research Group, 2007). These smoking-prevention programs are therefore a wonderful example of psychologists and government officials working together to improve people's health.

A new challenge that health officials must face is the issue of e-cigarettes or "vaping." Vaping is not quite as harmful as traditional smoking, but it is not a healthy habit, and can still result in nicotine dependence. Although it is technically illegal to advertise e-cigarettes in Canada, the enforcement of these laws has not been as stringent as for regular cigarettes. In the United States, advertising of these products *is* allowed. A recent study found that most of the exposure that adolescents had to e-cigarettes occurred on cable television networks (Duke et al., 2014). A report by the U.S. National Academy of Sciences (2018) concluded that adolescents who vape are more likely to try cigarettes. This should raise skepticism that vaping is the "safer alternative."

Obesity

Listen to the Audio

Most college and university students are familiar with the term "freshman 15"—the supposed number of pounds students can expect to gain during their first year of school (15 lb equals 6.8 kg). This term has stuck because weight gain during the first year of university (at least in North America) has become common, if not expected. It is unclear exactly how the term originated, and research has shown that the 15-lb estimate is actually inflated. In reality, male and female students who gain weight during their early university career put on an average of 2.7 kg (6 lb) (Gropper et al., 2009).

What accounts for this phenomenon? Several factors that are probably all too familiar to many readers: increased food intake, decreased physical activity, and, for many students, increased levels of alcohol consumption. The lifestyle changes that students face during university affect physical health. In addition, university in general (and the first year in particular) presents new challenges that bring on a great deal of both positive and negative stress, especially if students move away from home. The freshman 15 (or 6) and other health-related issues are based on lifestyle decisions we make. Six pounds (2.7 kg) is not a lot of weight—but habits formed during any period of time, freshman year or otherwise, can be difficult to break. In this section, we will examine factors that lead us to put on weight as well as ways to use our knowledge of psychology to help us lose it.

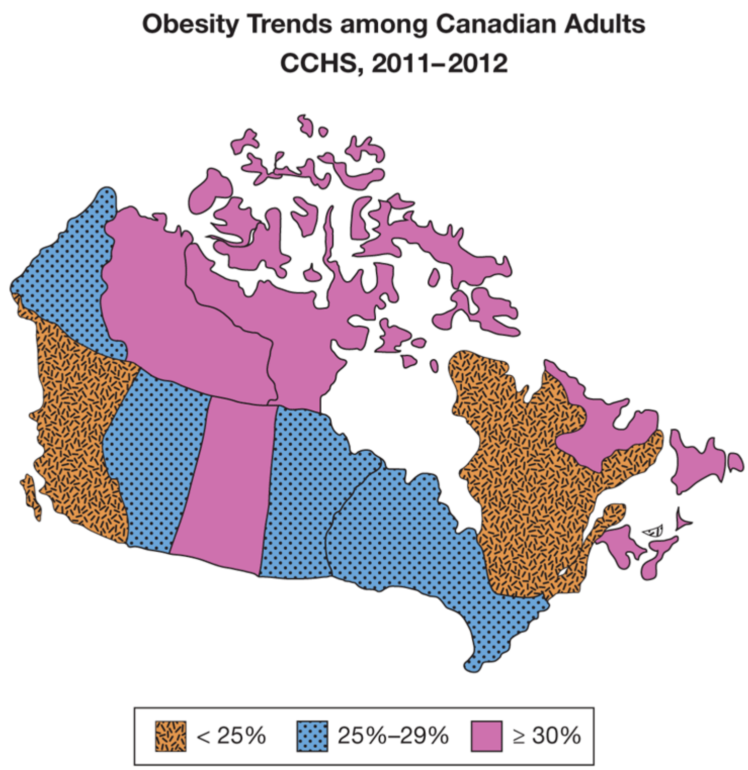
Defining Healthy Weights and Obesity

Listen to the Audio

It is important to define your terms when discussing a concept. Doing so ensures that all researchers are talking about the same thing when they use terms like *overweight* or *obese*. When discussing weight, psychologists and healthcare workers must also factor in a person's height; being 91 kg (200 lb) is healthy for someone who is 193 cm (6'4"), but would be quite unhealthy for someone who is 157 cm (5'2"). To account for height differences, people use the **body mass index (BMI)**, *a statistic commonly used for estimating a healthy body weight given an individual's height*. The BMI is calculated by dividing the person's weight (kg) by the square of the person's height (in m). So, if a person were 180 cm tall and weighed 100 kg, their BMI would be $100/1.8^2$; the outcome of this equation, 30.9, would be found on a table of BMI scores. In everyday usage, the BMI is used to screen people for weight categories that indicate whether they are considered normal weight, underweight, overweight, or obese. Someone in the healthy weight range would have a BMI between 18.5 and 24.9. People with a BMI that is less than 18.5 are considered to be underweight and may be at risk of having an eating disorder (see Module 11.1). A BMI of 25–29.9 is considered overweight, and a BMI over 30 is considered obese. However, BMI is only a useful statistic when studying a large group of people. Any one individual may deviate quite a bit from the standards. For example, a weightlifter is going to carry a lot of additional weight—muscle is much heavier than fat—and so a fit, muscular individual will have a higher BMI without necessarily being less healthy.

Obesity is becoming a growing concern across Canada. It is associated with numerous detrimental health consequences, such as cardiovascular disease, diabetes, osteoarthritis (degeneration of bone and cartilage material), and some forms of cancer. According to Statistics Canada (2011), 24% of Canadian adults are obese, with almost identical percentages for males and females, although these rates differ across provinces (see Figure 14.1). Although this number is significantly lower than the 34.4% obesity rate in the United States (Shields et al., 2011), we cannot afford to become arrogant. With a quarter of our population being obese and another quarter reporting a body mass index that is overweight, it is clear that body weight is a major health issue in our society. Even more alarming is that obesity rates are on the rise. When examining obesity rates from the mid-1970s until 2004, researchers found that these rates remained constant until the mid-1990s, at which point they spiked upward to the current levels (Shields & Tjepkema, 2006). This report also noted that Canadians—particularly males—are becoming obese earlier in life, which means that weight-related health problems could occur at an earlier age than they have for previous generations. In fact, some researchers are concerned that these health problems could lead to shorter life expectancies than were enjoyed by previous generations (Olshansky et al., 2005).

Figure 14.1 Obesity Rates in Canada



The rates of obesity differ from province to province. More information about Canadian obesity rates is available in the *2011–2012 Canadian Community Health Survey*.

Source: Based on data from Navaneelan, T., & Janz, T. (2014). Adjusting the scales: Obesity in the Canadian population after correcting for respondent bias. *Health at a Glance*. Statistics Canada Catalogue no. 82-624-X. Retrieved from www.statcan.gc.ca/pub/82-624-x/2014001/article/11922-eng.htm

Given that obesity is common *and* has a number of negative health consequences, researchers are actively trying to understand its causes. As discussed in Module 11.1, weight is gained because of a positive energy balance, meaning that too many calories come in and not enough are expended. Obviously, overeating can lead to obesity. But several other factors are involved as well, including genetic, lifestyle, and social variables.

Genetics and Body Weight

Listen to the Audio

Twin, family, and adoption studies all suggest that genes account for between 50% and 90% of the variation in body weight, and genome-wide studies implicate hundreds of genes that contribute to body weight (Maes et al., 1997; Riveros-McKay et al., 2019). These genes influence body type, metabolism, and other physiological processes that contribute to body weight and size. For example, the Fat Mass and Obesity Related (also known as FTO) gene is a risk gene for obesity, with a variant of this gene associated with elevated food intake (Speakman, 2015). But this gene and the many others involved in body weight also interact with lifestyle and environmental factors.

Some researchers have suggested that genes contribute to the development of a **set point**, *a hypothesized mechanism that serves to maintain body weight around a physiologically programmed level*. The set point is not an exact number of kilograms or pounds, but rather a relatively small range encompassing 10% to 20% of a person's weight (Garrow & Stalley, 1975; Harris, 1990). Your initial set point is controlled by genetic mechanisms, but your actual weight can be modified by environmental factors—namely, what and how much you eat. According to set point theory, if an individual gains 10% of their body weight (e.g., increasing from 68 kg to 75 kg or 150 lb to 165 lb) their set point would make a corresponding shift upward—the body acts as though its normal weight is now the larger 75 kg. Metabolism slows correspondingly, such that this person now requires additional energy expenditure to take the

weight off. This process explains why people who gain extra weight may shed a few pounds with relative ease, but find it overwhelmingly difficult to continue losing or even maintaining their weight once they reach an initial goal. Their bodies naturally pull their weight back to the set point.

Set point theory has a long tradition in the field of nutrition, but its validity is challenged by research suggesting that weight gain and difficulty with weight loss are unrelated to a physiological set point. Rather, individual differences in physical activity may be a stronger determinant of who succeeds at losing weight and keeping it off. Specifically, people who gain weight expend less energy in their normal day-to-day activities (Weinsier et al., 2002). Thus, the difficulty with losing the weight may be related to lower activity levels, rather than to an increase or decrease in a person's set point.

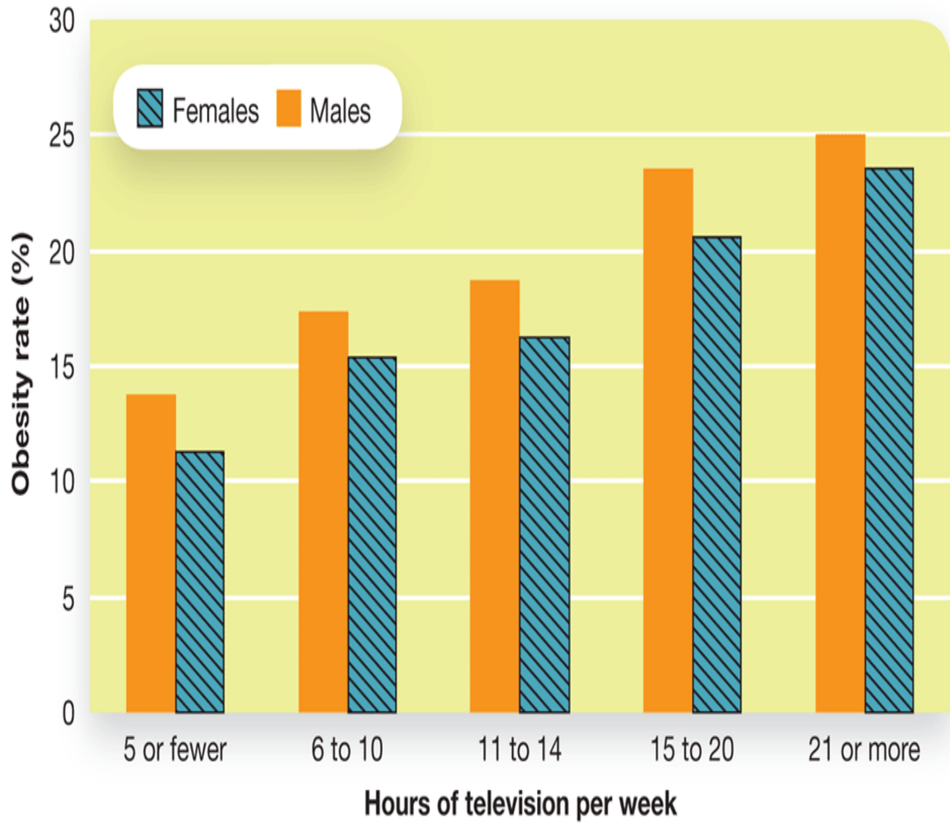
The Sedentary Lifestyle

Listen to the Audio

How do you spend your time when you're not at school or at work? Do you watch television? Or do you work out, or curl up with a good book? Research shows us that how you spend your time can have a large effect on your waistline.

Although there are number of activities that could increase the likelihood of someone being obese, data from the 2007 Canadian Community Health Survey (CCHS) suggest that television is the biggest culprit (see Figure 14.2). This survey showed that as the number of hours of television viewing increased, so did obesity rates. Only 13.7% of men who watch five or fewer hours of television per week were obese; compare this to the 25.0% obesity rate for men who watched 21 or more hours of television. Similar patterns were observed for females.

Figure 14.2 Obesity Rates and Television Viewing in Canadian Adults Aged 20–64



For both males and females, obesity rates were positively correlated with the number of hours spent watching television each week.

In contrast, the number of hours spent in front of a computer did not affect obesity rates, at least in males; females who spent more than 11 hours/week in front of a computer had a *slightly* higher rate of obesity than those who spent little time using a computer (18.2% vs. 15.3%, respectively). Why was there a strong relationship between television viewing and obesity and a weak relationship between computer use and obesity? Both involve sitting in front of glowing rectangles. One possibility is that computer use—be it video games, social media like Instagram or Twitter, or even typing up an essay for history class—involves a greater degree of engagement than sitting on the couch and passively watching television. It is therefore more likely that people will snack while watching television. One point worth considering is that TV

viewing and computer use are becoming one and the same activity, as online streaming services are replacing conventional TV programming. It will be interesting to see what the obesity-related data trends look like in the near future.

Studies of children's obesity rates are less ambiguous. In addition to the strong relationship between television viewing and weight, researchers also have found that the amount of time that children spend playing video games is positively correlated with levels of obesity (Stettler et al., 2004). Although some video game systems such as the Wii involve physical activity, these options claim only a small portion of the overall market, and that market segment is rapidly shrinking. Instead, many games involve sitting in front of a computer or television screen rather than engaging in exercise. This sedentary lifestyle can lead to poor dietary and exercise habits (which may continue into adulthood), and helps to explain the high childhood obesity rates found in many industrialized countries, including Canada.

Social Factors

Listen to the Audio

In addition to genetics and activity levels, obesity rates are also affected by social factors, including influences from one's family. Similarities in body weight among family members are naturally influenced by what and how much they are eating. What children eat is largely based on what their parents provide and allow them to eat, and eating patterns developed in childhood are generally carried into adulthood.

Sociocultural influences on eating certainly extend beyond the family. Food advertisements trigger eating—after watching a commercial for buttery microwave popcorn, you may have found yourself rummaging around in the kitchen in search of that last bag you hope is still there. Researchers have found that children who see food commercials while watching a 30-minute cartoon program consume 45% more snack food than do children who view non-food commercials. The researchers estimated that this difference could lead to an additional 4.5 kg (10 lb) of extra weight gained each year (Harris et al., 2009). Of course, corporations selling unhealthy food are aware of the power of advertising and use clever marketing techniques to promote unhealthy foods, often targeting children by linking their food with positive emotions (and toys).

Psychology and Weight Loss

Listen to the Audio

How can people use psychological research to help them lose weight? The first step is to think critically about the weight-loss options that are out there. Some advertisements tell people that they can lose weight without exercising, just by taking a pill. Such options are often gimmicks. Instead, we need to find a way to effectively motivate people to change their behaviours (i.e., to eat healthy foods and exercise). A study from the University of Waterloo suggests that thinking positively about the self can promote healthy weight loss. In the first part of the study, participants wrote about either self-defining values that made them feel positively about themselves (e.g., friendships, religious beliefs, relationships) or about other values. At a follow-up session two-and-a-half months later, the self-defined value group weighed less, had lower body mass indices, and had smaller waistlines (Logel & Cohen, 2012). It is likely that the positive emotion manipulation reduced the participants' stress regarding dieting. Given that stress leads to an increase in the number of calories consumed (see Module 11.1), reducing stress could lead to a reduction in the amount of food consumed. Researchers at Wilfrid Laurier University found that mindfulness is positively related to healthy eating habits. In other words, people who are tuned into their current emotional and physiological states are more likely to make healthier food choices (Jordan et al., 2014).

Of course, losing weight is only half the battle; we also have to maintain that weight loss. There are a number of challenges involved with this.

First, obese individuals pay more attention to food cues (Polivy et al., 2008) and find them more rewarding than non-obese people (Stice et al., 2008). Additionally, the drive to eat and the perceived value of food increase as more time passes since the last meal (Raynor & Epstein, 2003); this makes it difficult to remove snacks from your routine. Several studies have shown that girls and adolescents who attempt to diet are heavier later in life (Field et al., 2003; Stice et al., 2005). The restraint involved in dieting—especially avoiding certain highly reinforcing foods—may actually make the foods even more reinforcing in the long run. All of these factors help explain why obesity is such a difficult condition to overcome—it's not simply a matter of losing a few pounds.

Psychosocial Influences on Health

Listen to the Audio

The environments where we work, live, and play and the people with whom we interact influence both our physical and mental health. This fact seems fairly obvious, but its importance is sometimes overlooked. Think about the neighbourhoods in your city. Some are wealthy; others are economically disadvantaged. Some are safe; others have higher crime rates. Consider the experiences that children would have growing up in each of these neighbourhoods. How would their lives differ? And how would these experiences affect their well-being?

Poverty and Discrimination

Listen to the Audio

Health and wealth increase together. People who live in affluent communities not only enjoy better access to health care, but also have a greater sense of control over their environments and have the resources needed to maintain a lifestyle of their choosing. Individuals who lack this sense of control live in circumstances that can compromise their health. People who experience poverty, discrimination, and other social stressors have higher incidences of depression, anxiety, and other mental health problems (Tracy et al., 2008).

People who are of low socioeconomic status are at increased risk for poor health. Numerous factors, including stress, poor nutrition, discrimination, and limited access to health care, collectively place children growing up in these communities at greater risk for developing health problems.

BrandyTaylor/E+/Getty Images

Furthermore, health problems are magnified by stress. Heart disease is prevalent in socioeconomically disadvantaged populations, and children who experience adverse socioeconomic circumstances (e.g., fewer than 12 years of education or living in a low-income household) are at greater risk for developing heart disease in adulthood (Fiscella et al., 2009; Galobardes et al., 2006). This relationship likely reflects the compound effects of stress, as well as the poorer diet that is often found among individuals residing in communities of low socioeconomic status.

Discrimination is another stressor that can compromise both physical and mental health. This kind of stressor is particularly problematic because it is often uncontrollable and unpredictable. Being a target of prejudice and discrimination is linked to increased blood pressure, heart rate, and secretions of stress hormones, which when experienced over long periods of time compromise physical health (Busse et al., 2017). For example, when people perceive that they are the targets of racism, their blood pressure remains elevated throughout the day and it recovers poorly during sleep (Brondolo et al., 2008a, 2008b; Steffen et al., 2003). Discrimination also puts people at greater risk for engaging in unhealthy behaviours such as smoking and substance abuse (Bennett et al., 2005; Carliner et al., 2016). Finally, discrimination, or even the perception of discrimination, can put the body on sustained alert against threats. The stress response that this state elicits can have negative, long-term effects on physical health, as you will read in Module 14.2.

Family and Social Environment

Listen to the Audio

Our close, interpersonal relationships have a major impact on health and life satisfaction (Elgar et al., 2011). In fact, chronic social isolation is as great a mortality risk as smoking, obesity, and high blood pressure (Cacioppo & Cacioppo, 2014). **Social resilience**, *the ability to keep positive relationships and to endure and recover from social isolation and life stressors*, can protect individuals from negative health consequences of loneliness and social isolation (Cacioppo et al., 2011).

Marriage is typically the primary social relationship that people establish, and it has been shown to have long-term health benefits. Married people tend to live longer and have better mental and physical health than do nonmarried adults. Married couples enjoy the benefits of social support and combined resources, and they tend to have better health habits.

This is good news for married couples, but are both members of a heterosexual marriage benefiting equally from their union? It turns out that men enjoy greater health benefits from marriage. Unmarried women are 50% more likely to die from heart disease, several forms of cancer, cirrhosis of the liver, and other preventable diseases than are married women; this effect of marriage is even higher in men, with unmarried men being 250% more likely to die from these causes (Berkman & Breslow, 1983; Ross et al., 1990). Several possible reasons for this disparity in the health benefits gained from marriage have been

suggested. One likely contributor is the greater role that women take in recognizing and supporting healthy behaviours in others.

It should be noted that heterosexual marriages are not the only form of relationship. Currently, there are relatively little data about the health benefits of homosexual marriages. The studies that do exist indicate that legally recognized marriages (like we have in Canada) provide similar benefits as found for heterosexual couples (Goldsen et al., 2017; Riggle et al., 2010; Wight et al., 2013). As more countries and U.S. states legalize these marriages, it will be possible to investigate whether both partners benefit equally or if, like heterosexual marriages, one partner appears to gain more health benefits than the other. For now, we can conclude that at least part of the health benefit stems from the fact that legalization of marriage for homosexual couples improves access to health insurance (in the United States) and primary care (Carpenter et al., 2018).

Of course, marriage can also be a considerable source of stress. Marital problems are among the most stressful experiences that people can have. Married couples who are experiencing ongoing problems with their relationship tend to experience more depression and greater incidences of physical illness than happily married couples (Kiecolt-Glaser & Newton, 2001). Marital problems and divorce may affect the emotional health of some, though certainly not all, children. For example, adolescents of divorced parents are at a slightly higher risk of engaging in delinquent behaviours (Amato, 2001). While divorce can negatively affect the health of children, parents who continue engaging in high-quality parenting during marital discord protect children from many of the negative effects on health attributable to divorce (Hetherington et al., 1998).

Social Contagion

Listen to the Audio

Families are not the only interpersonal influence on how we think and act. The social group(s) that we belong to can also have a large effect on our health-related behaviours. Social scientists have found that unhealthy behaviours such as smoking or having a poor diet spread throughout a person's social group. You have likely observed this phenomenon in action—if one or two people in a group of friends start to eat a lot of junk food, it is easy for the others in the group to pick up this habit as well. These changes can work in either direction, positively or negatively. Just as social-group influence can lead to smoking, it can also lead to training for a half-marathon.

Social contagion in the dorms: Your roommate may influence your GPA more than you know—for better or for worse. At Dartmouth College in the United States, students are randomly assigned to their dorm rooms rather than matched on various characteristics, as is customary at many schools. This practice makes Dartmouth's roommate pairs a diverse mixture. Professor Bruce Sacerdote (2001) found that GPA levels are influenced by a person's roommate. Students with high GPAs elevate the GPAs of their lower-scoring roommates, and vice versa.

James Woodson/DigitalVision/Getty Images

These phenomena are examples of **social contagion**, *the often subtle, unintentional spreading of a behaviour as a result of social interactions*. Social contagion of body weight, smoking, and other health-related behaviours has been documented in the Framingham Heart Study. The U.S. National Heart Institute began this ongoing study in 1948 to track 15 000 residents of Framingham, Massachusetts. Participants made regular visits to their doctors, who recorded important health statistics such as heart rate, body weight, and other standard physical measures. Scientists working with the Framingham data noticed that over time, clusters of people from this study group became increasingly similar in certain characteristics—such as body weight increases or decreases, starting or quitting smoking, and even levels of happiness (Christakis & Fowler, 2007, 2008; but see Lyons, 2011). It turns out that the groups who showed similar patterns in their health statistics were also friends with one another. This work may demonstrate the power of social factors on behaviour. Of course, this research doesn't only mean that you should be wary of your friends and their unhealthy behaviours. It also shows that through social contagion, you can be a positive force in the lives of the people around you.

#Psych

Social Media and Your Health

The internet, and social media in particular, is a primary means through which people obtain information about health and health-related products. While some of this information is backed by good science (Cole et al., 2016), much of it ranges from being outright false (e.g., that vaccines cause autism) to having shreds of truth. For example, recently around 200 000 people discontinued taking highly effective statin medications for cardiovascular health because they read popular press reports of two scientific studies claiming that the drugs cause major adverse side effects. All drugs have potential side effects, and it turns out the authors of the studies were not careful in how they interpreted cause (taking the drugs) and effect (harmful reaction to the drug; Matthews et al., 2016).

Overstating cause-and-effect relationships is common in popular reports of scientific studies, including those involving our health. A correlation revealing a relationship between eating organic produce and having good physical health all too easily gets interpreted as causal (e.g., eating organic food makes you healthier). Numerous other variables, having nothing to do with organic food, may explain good physical health. People who choose to pay for organic food may just be more health conscious, have higher income, exercise more, and, in the United States, have quality health insurance. Here lies one of the greatest problems with using social media for health and medical advice. Haber and colleagues (2018) examined 50 health-related articles shared on Facebook and Twitter and found that about half of them overinterpreted or incorrectly interpreted the cause-and-effect relationships from scientific studies. Over half of the social media articles analyzed were inaccurate about details from the research questions and results. What is the take-home message here? By the time

research findings go from the laboratory to social media channels, the science can get highly misconstrued. Taking good care of your health involves awareness of this fact.

Module 14.1 Summary

Listen to the Audio

14.1a Know . . . the key terminology related to health psychology.

Review Module 14.1

Start Over Swap

0/4 REVIEWED · 0 MASTERED

set point

Previous Next Got It!

14.1b Understand . . . how genetic and environmental factors influence obesity.

Some research suggests that genetics influences our set point, a weight (or range of weights) that our body tends to maintain; however, weight is

influenced by several other factors as well. Environmental influences on weight gain are abundant. Cultural, family, and socioeconomic factors influence activity levels and diet, even in very subtle ways, such as through social contagion.

14.1c Apply . . . your beliefs about obesity to better understand sources of prejudice and stereotyping.

Apply Activity

Stereotypes and prejudicial attitudes are commonly directed at people who are overweight or obese. Bacon and colleagues (2001) created a fat phobia scale as a metric for measuring thoughts about people who are obese. You can complete their brief scale below. For each adjective, identify which number best represents your feelings and beliefs about people who are obese. After you have done this for each item, total up the numbers and divide by 14.

1	Lazy	5	4	3	2	1	Industrious
2	No will power	5	4	3	2	1	Has will power
3	Unattractive	5	4	3	2	1	Attractive
4	Poor self-control	5	4	3	2	1	Good self-control
5	Slow	5	4	3	2	1	Fast
6	Having no endurance	5	4	3	2	1	Having endurance
7	Inactive	5	4	3	2	1	Active
8	Strong	5	4	3	2	1	Weak
9	Self-sacrificing	5	4	3	2	1	Self-indulgent
10	Likes food	5	4	3	2	1	Dislikes food
11	Shapely	5	4	3	2	1	Shapeless
12	Overeats	5	4	3	2	1	Undereats
13	Insecure	5	4	3	2	1	Secure
14	Low self-esteem	5	4	3	2	1	High self-esteem

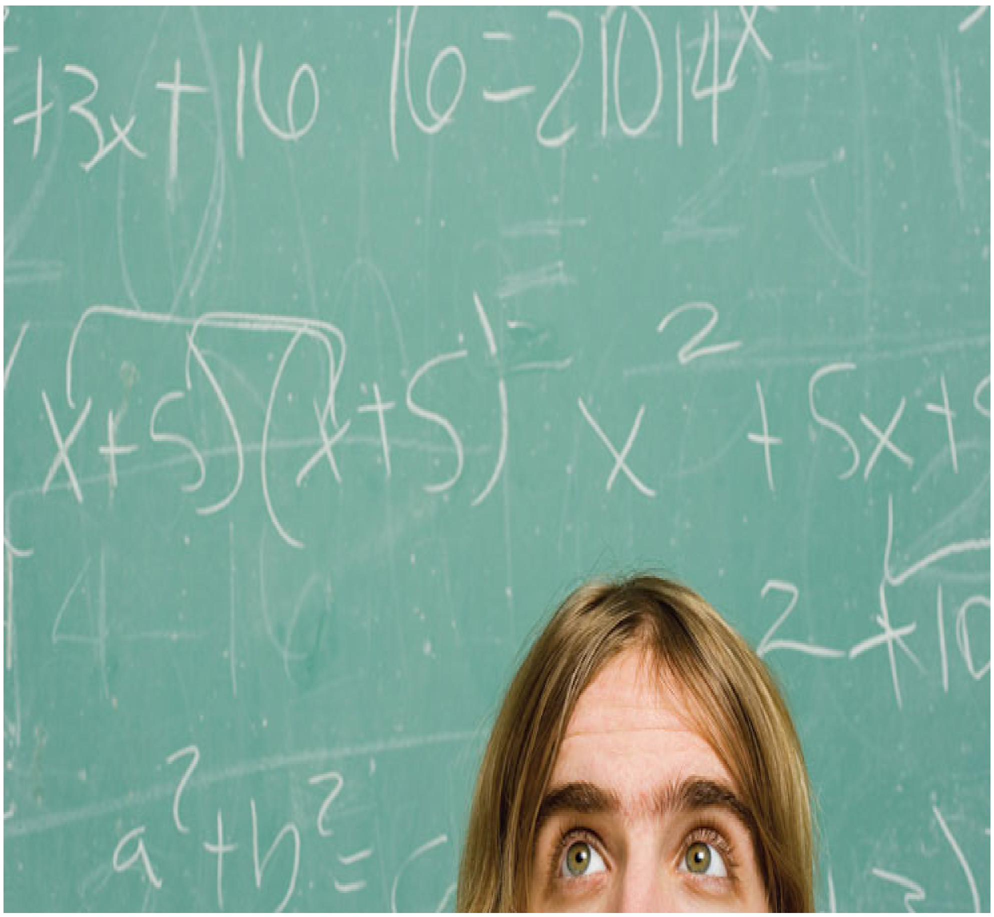
If you wish, compare your number to a large-scale study conducted by the researchers who designed the survey (Bacon et al., 2001). Scores range from 1 to 5, with 5 indicating the highest levels of negative attitudes toward fat people. The average score in their study was 3.6. Considering your own beliefs and thoughts about people who are overweight or obese can be an important step toward reducing prejudicial attitudes toward others, and toward recognizing negative stereotypes expressed by others. As you have read in this module, there are numerous biological, sociocultural, and economic factors that influence a person's body weight.

14.1d Analyze . . . whether media depictions of smoking affect smoking in adolescents.

Correlational trends certainly show that smoking in popular movies is positively correlated with smoking among adolescents (e.g., increased exposure is related to increased incidence of smoking). Controlled laboratory studies suggest a cause-and-effect relationship exists between identification with story protagonists who smoke and smoking behaviour by young viewers.

Module 14.2 Stress and Illness

Listen to the Audio



Imagesource/Glow Images

Learning Objectives

14.2a Know . . . the key terminology associated with stress and illness.

14.2b Understand . . . the physiological reactions that occur under stress.

14.2c Understand . . . how the immune system is connected to stress responses.

14.2d Apply . . . a measure of stressful events to your own experiences.

14.2e Analyze . . . the claim that ulcers are caused by stress.

The frustration and embarrassment of choking under pressure is undeniable. Whether the stakes are a championship title or admission to an elite university, a sudden, inexplicable shift to subpar performance can be devastating. According to psychologist Sian Beilock, the culprit in such a case may be the negative effects that stress has on working memory—the short-term capacity to hold and manipulate information. Calculating a 15% tip for a bill of $43.84 at a restaurant, or while the pizza delivery person waits, requires working memory processes. The pressure of your date watching you or the pizza delivery person looking on impatiently may result in your appearing either foolishly generous or just plain cheap.

Beilock has conducted experiments on how stress affects the cognitive resources needed for problem solving. For example, in one study, research volunteers were asked to solve math problems. Some were told that if they solved the problems correctly, they would earn money for themselves as well as for a partner they were paired with; if they did not perform well, both the volunteer and the partner would lose money. Beilock and her colleagues have found that this type of pressure draws resources away from the working memory processes needed for success (Beilock, 2008, 2010). Stressful thoughts readily occupy working memory space and cause the unfortunate experience of choking under pressure. This fact may contribute to findings from an analysis of 1930

NBA playoff games showing that facing elimination does not lead to elevated performance (Morgulev & Galily, 2018). Even highly skilled professionals choke under pressure.

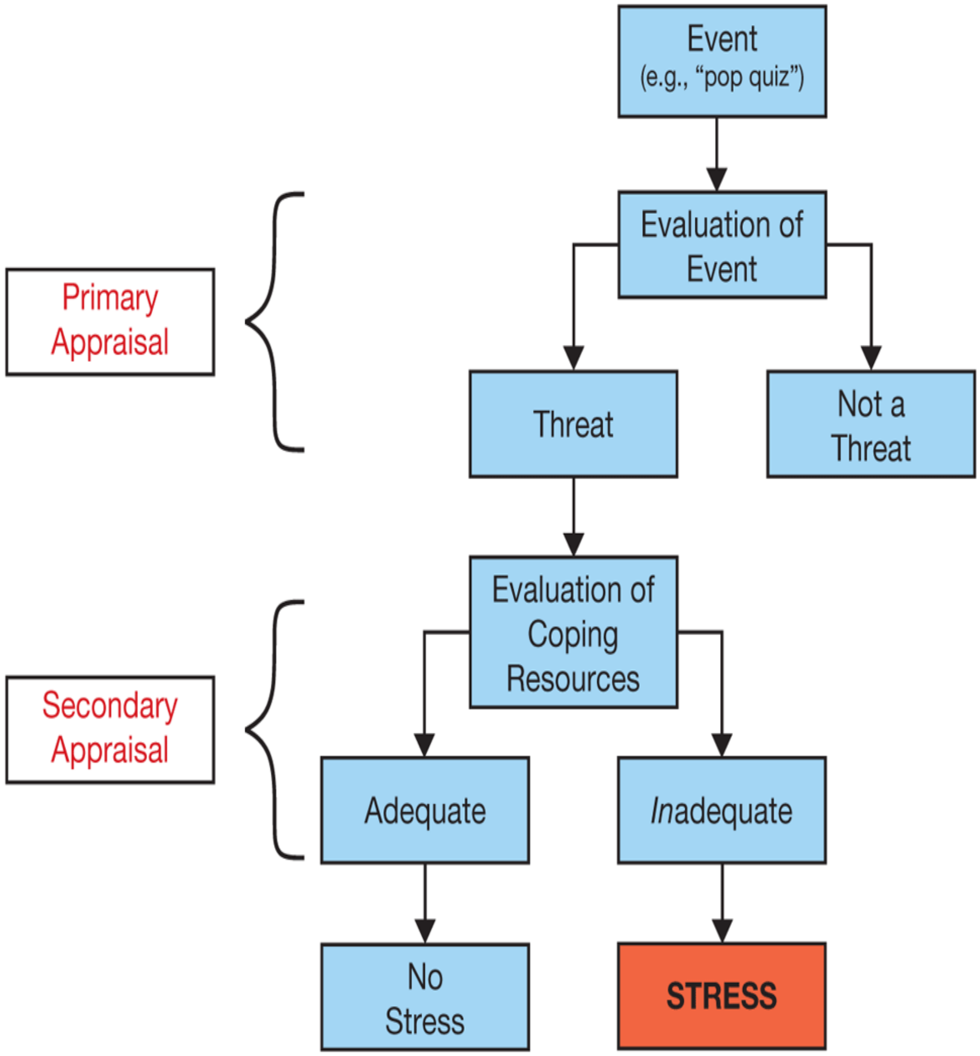
Imagine a student near the end of the semester with several papers due and final exams looming. Now imagine someone who has worked at the same job for 25 years being told that he needs to learn a new computer system or he will be laid off. Or think about a soccer player in a championship game that will be decided by penalty kicks; she walks up to place the ball on the penalty spot, knowing that if she misses her team will lose. If you were asked to find one word that connected all of these scenarios, what word would that be? For most people, that word would be stress. **Stress** *is a psychological and physiological reaction that occurs when perceived demands exceed existing resources to meet those demands*. Stress refers to both events (stressors) and experiences in response to these events (the stress response). Stressors can take a wide variety of forms, such as acute events (giving a speech, experiencing an assault, getting in a car accident) and chronic events (illness, marital problems, job-related challenges). The effects these stressors have on performance can be positive or negative.

What Causes Stress?

Listen to the Audio

Have you noticed how some people seem overwhelmed by stressful events while others seem calm and focused? These differences are not a figment of your imagination—people do differ in their responses to stress. To attempt to explain why and how people differ, psychologists Richard Lazarus and Susan Folkman developed a cognitive appraisal theory of stress (Lazarus & Folkman, 1984). Here, the term **appraisal** refers to *the cognitive act of assessing and evaluating the potential threat and demands of an event*. These appraisals occur in two steps (see Figure 14.3). First, the individual perceives a potential threat and begins the *primary appraisal* by asking, "Is this a threat?" Threats can be physical (e.g., someone trying to harm you) or psychosocial (e.g., trying to study for two exams on the same day or trying to deal with interpersonal conflicts). If the answer is no, then they will not experience any stress. But if the answer is yes, they will experience a physiological stress reaction (perhaps a racing heart beat and sweaty palms) as well as an emotional reaction (perhaps anxiety and fear). As these events unfold, the *secondary appraisal* begins—they must determine how to cope with the threat. During the secondary appraisal, they may determine that they know how to cope with the stressor (e.g., studying for the exams over the course of several days). In this case, they will not feel much stress. However, if they believe that the stressor goes beyond their ability to cope, the physiological and emotional reactions to the stress will continue.

Figure 14.3 The Cognitive Appraisal Theory of Stress



The cognitive appraisal theory of stress involves two steps: (1) an evaluation of whether a stimulus or event is a threat, and (2) whether you have the resources to cope with that threat.

Although the causes of stress can vary from person to person, there are some patterns that tend to emerge. In the workplace, Canadians experience stress due to long hours, high work demands, safety concerns, and interpersonal relationships (Crompton, 2011). Life changes such as marital difficulties, the birth of a child, or the death of a family member are also a major source of stress. Psychologists have actually ranked stressful events according to their magnitude, as can be seen in the Social

Readjustment Rating Scale (SRRS) in Table 14.2 (Holmes & Rahe, 1967). The highest-stress events include death of a spouse and divorce, while holidays and traffic tickets occupy the lower end of the spectrum. According to the psychologists who developed this scale, as the points in the left column of Table 14.2 accumulate, a person's risk for becoming ill increases. For example, 300 or more points put people at significant risk for developing heart problems, illnesses, and infections.

Table 14.2

Life Stress Inventories for the General Adult Population and for University Students

Table 14.2 Life Stress Inventories for the General Adult Population and for University Students

The Social Readjustment Rating Scale (Holmes & Rahe, 1967) With Some Minor Updates	
RATING	ITEM
100	Death or major illness of a loved one
73	Parental divorce
65	Marital problems
63	Going to jail
53	Injury or illness to the self
50	Getting married
47	Being fired from work
45	Retiring
40	Pregnancy
39	Difficulty with sexual functioning
39	Addition of a new family member
38	Financial hardship
36	Career/occupation change
35	Spousal arguments
31	High mortgage payment
29	Child moving away from home
28	Notable personal achievement
26	Beginning or ending of school
25	New living conditions
23	Trouble with work supervisor/boss
20	Change or adjustment in residence situation
20	Changing schools
19	Change in recreation activity
16	Change in sleep habits/duration
15	Change in diet
13	Vacation
11	Minor violations of the law (e.g. traffic ticket)
Total	

Source: Based on Holmes, T. H. & Rahe, R. H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research*, *11*(2), 213–221.

Of course, the stresses that a young adult experiences are almost certainly different from the stresses that are experienced by their parents or grandparents. Although students *can* have all of the stresses listed in the right-hand column of Table 14.2, it is more likely that students will deal with issues related to school work, a lack of money, and all of the social excitement (and drama) associated with their late teens and early 20s. Many Canadian students also deal with the challenges associated with

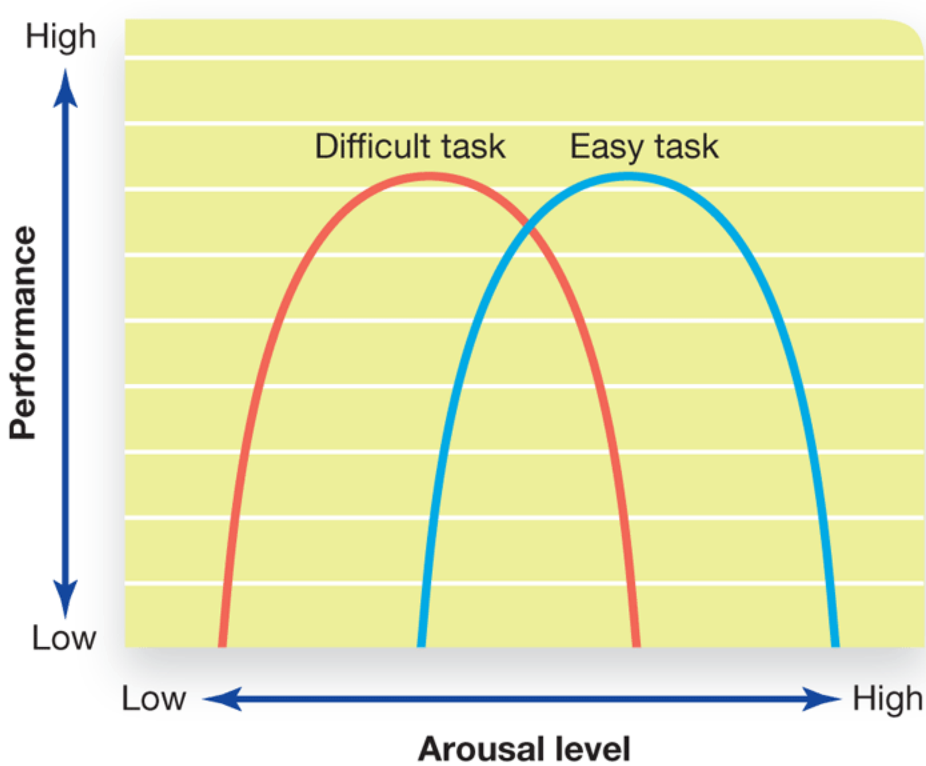
immigration—balancing the family's traditions with the desire to embrace Canadian culture (Safdar & Lay, 2003).

Stress and Performance

Listen to the Audio

At this point in the module, it would appear as though stress were always a bad thing. However, some level of stress can actually be helpful—without it, the motivation to perform can decline. In 1908, Robert Yerkes and John Dodson theorized that too little or too much stress or emotional arousal would both lead to sub-optimal performance. Individuals would be at their best when under a moderate amount of stress. This relationship is depicted in Figure 14.4.

Figure 14.4 Arousal and Performance



Performance is related to at least two critical factors—the difficulty of the task and the level of arousal/stress while it is being performed. For easy tasks, moderately high arousal helps; for difficult tasks, lower levels of arousal are optimal.

Source: Ciccarelli, S., & Noland White, J. (2012). *Psychology* (3rd ed.). Boston: Prentice Hall. p. 39.

Later research found that the link between stress and performance could vary with the task being performed. Researchers noted that stress has positive effects on performance when the tasks being completed are relatively simple (see Figure 14.4). In this case, even if the stress consumes the person's cognitive resources, it will still be possible to complete the task. However, if a task is complex, stress will harm performance. This is because stress uses up many of our cognitive resources. A stressed-out person may find that they do not have the mental resources available to perform at the level they would be capable of if they were not experiencing stress.

Importantly, the stress levels associated with these graphs are not the same for everyone. Some people seem to thrive under intense stress while others do not. It appears that almost everyone has an **individual zone of optimal functioning (IZOF)**, *a range of emotional intensity in which he or she is most likely to perform at his or her best* (Hanin, 2000; Kamata et al., 2002). Sports psychologists have found that if an athlete is too anxious and stressed out—*or not stressed out enough*—they will not perform at an optimal level. Critically, many elite athletes are able to compare their current emotional state with the level of stress they had experienced prior to good performances; they can then attempt to adjust their current state to more closely match their optimal one (Jokela & Hanin, 1999).

The data described in this section leads to an obvious question: *How* does a physiological response—stress—affect our mental life and cognitive abilities? In the next section of this module, we will examine how your brain and body can produce the *feelings* and *sensations* associated with the experience of stress.

Physiology of Stress

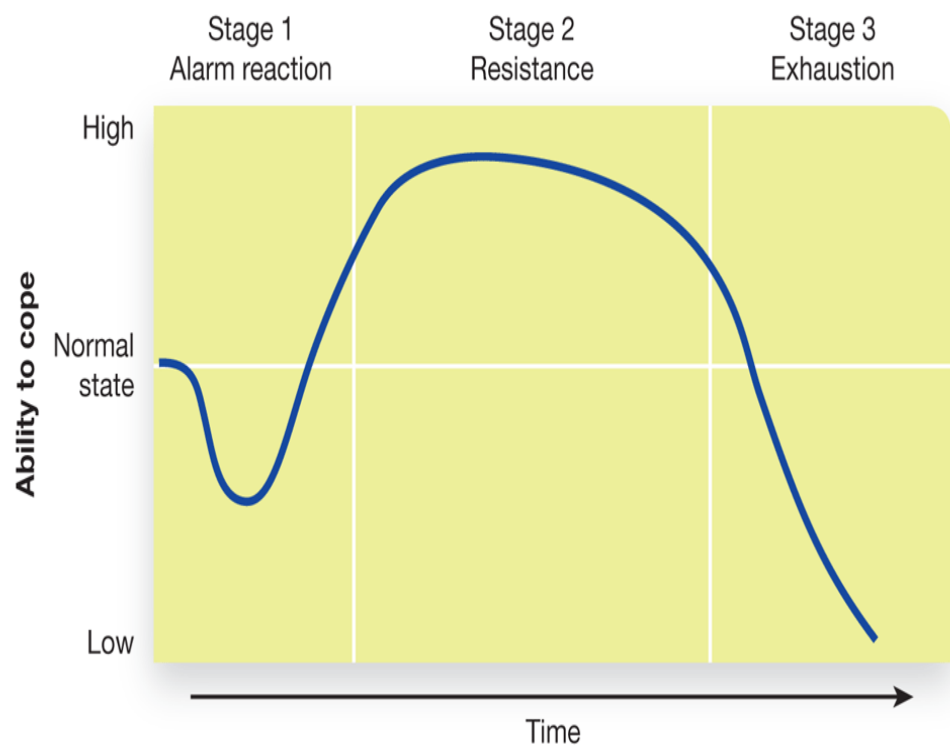
Listen to the Audio

Think about the last time you experienced stress. How did you *feel*? Although stress depends upon our mental appraisal of a situation or event, the physiological response to stress occurs throughout most of the body. Indeed, you can literally feel yourself react to acute stressors, such as giving a presentation in class, as well as chronic stressors, such as the cumulative effect of a challenging school year. Walter Cannon (1929), an early researcher into the phenomenon of stress, noted that the physical responses to stressors were somewhat general, despite the fact that stress can come from a variety of sources that may be biological, cognitive, or social in nature. Cannon described this general reaction as a **fight-or-flight response**, *a set of physiological changes that occur in response to psychological or physical threats*. This discovery laid the foundation for the modern study of stress, with several researchers building upon Cannon's pioneering work.

Watch Basics: Stress and Health

Hans Selye (1950, 1956) of the Université de Montréal looked beyond the immediate fight-or-flight response and saw the unfolding of a larger pattern during responses to stress. He named this pattern the **general adaptation syndrome (GAS)**, *a theory of stress responses involving stages of alarm, resistance, and exhaustion* (see Figure 14.5). As GAS illustrates, a stressful event, such as a mild shock if you are a rat or a pop quiz (or a mild shock) if you are a university student, first elicits an *alarm* reaction. Alarm consists of your recognition of the threat and the physiological reactions that accompany it, including increases in blood pressure, muscle tension, heart rate, and adrenaline release. As the stressful event continues, the individual enters the second part of this adaptive response, known as *resistance*. Resistance is characterized by an individual using their physical and mental resources to respond to the stressor in an appropriate way (e.g., furiously studying for a quiz or running away from predators). However, an animal (or student) can't maintain this level of energy use forever. The third and final stage of the GAS is often referred to as *exhaustion*; this occurs when the stressful experience depletes your physical resources and your physiological stress response, and thus your ability to cope, declines.

Figure 14.5 The General Adaptation Syndrome



How we respond to stress varies over time. After the initial shock associated with the stressor (see the dip in resistance early in the Alarm phase), the body recruits resources to allow it to deal with the stressful situation or event. This ability to cope with the stressor peaks in the Resistance phase of the GAS. However, if the individual doesn't overcome the stressor, eventually they will be unable to resist the stress; this final phase is known as the Exhaustion phase.

Source: Based on Selye, H. (1950). Stress and the general adaptation syndrome. *British Medical Journal*, 1385–1392.

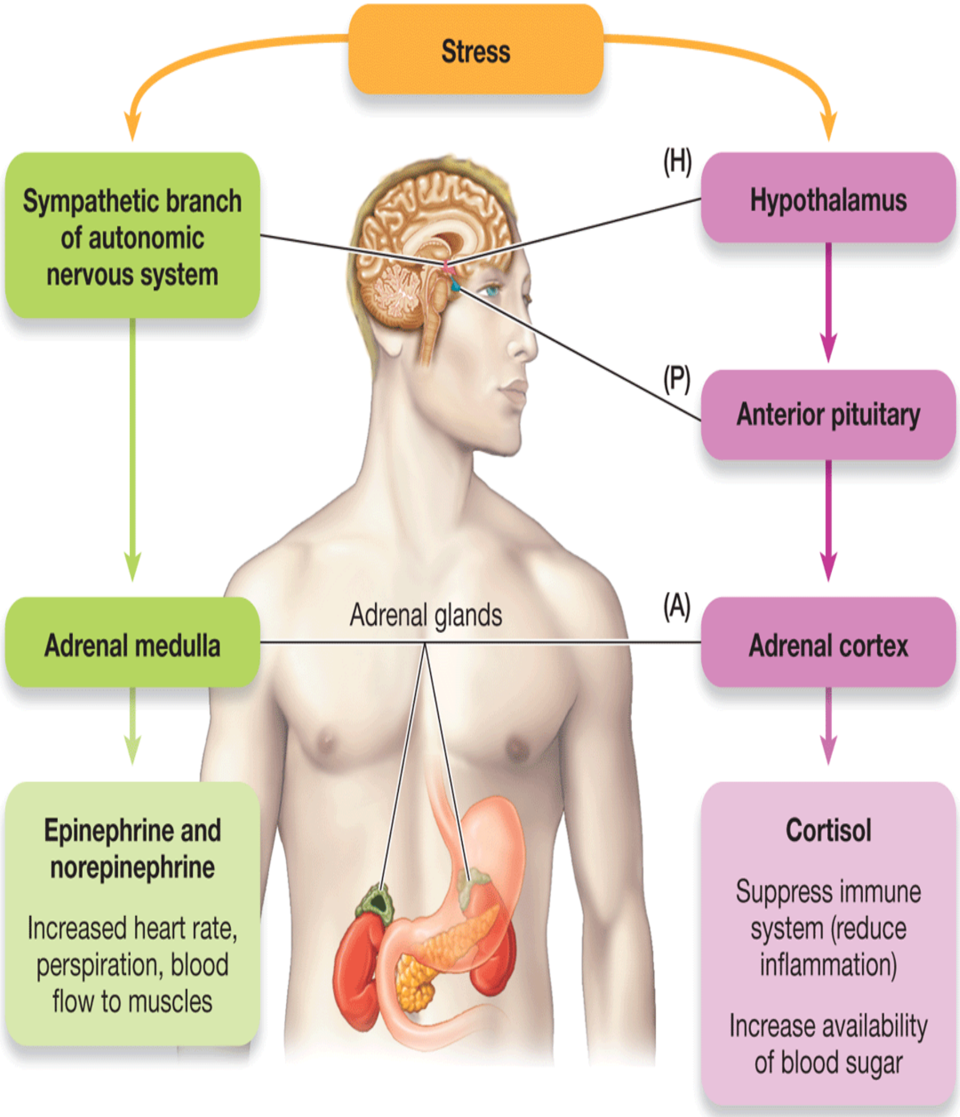
Since the work of Cannon and Selye, psychologists have further uncovered the highly complex physiological interactions that occur during and after stress. Modern descriptions of the physiology of stress involve both the autonomic nervous system (ANS) and endocrine (hormone) responses.

The Stress Pathways

Listen to the Audio

Sweaty palms, an increased heart rate, and gastrointestinal sensations (i.e., “butterflies in the stomach”) are part of stress responses to both positive and negative events. Many of these bodily responses are the result of activity in the autonomic pathway, which originates in the brain and extends to the body where you *feel* stress the most. Recall from Module 3.3 that the nervous system consists of the central nervous system (brain and spinal cord) and the peripheral nervous system, which includes the ANS. In response to stress, the hypothalamus stimulates part of the ANS known as the sympathetic nervous system, which then causes the inner part of the adrenal glands known as the *adrenal medulla* (found on top of the kidneys) to release epinephrine and norepinephrine (also known as adrenaline and nonadrenaline). These chemicals then trigger the bodily changes associated with the fight-or-flight response (see Figure 14.6).

Figure 14.6 Stress Pathways of the Body



The stress pathways of the body include the autonomic nervous system and the HPA axis. Both systems converge on the adrenal glands. The autonomic response involves stimulation of the adrenal medulla by the sympathetic nervous system, resulting in the release of epinephrine and norepinephrine—chemicals that stimulate the fight-or-flight response. Activity of the HPA axis results in stimulation of the adrenal cortex, which releases cortisol into the bloodstream.

Another physiological system involved in the stress response is the **hypothalamic–pituitary–adrenal (HPA) axis**, *a neural and endocrine circuit that provides communication between the nervous system (the*

hypothalamus) and the endocrine system (pituitary and adrenal glands). When you perceive that you are in a stressful situation, the hypothalamus and pituitary gland work together to stimulate the release of **cortisol**, *a hormone secreted by the adrenal cortex (the outer part of the adrenal gland) that prepares the body to respond to stressful circumstances*. Cortisol may stimulate increased access to energy stores or lead to decreased inflammation. In summary, both the sympathetic nervous system (through the release of epinephrine and norepinephrine) and the HPA axis (through the release of cortisol) function to prepare us to respond to stress.

With rare medical exceptions, humans mount both autonomic and HPA axis responses to stress. These responses are highly adaptive and promote behaviours that help our survival (e.g., being more vigilant or running extra fast). However, as you will see, not everyone responds to these stress responses in the same way.

Watch The HPA Axis

Oxytocin: To Tend and Befriend

Listen to the Audio

One observation you have likely made is that males and females often respond to stress and threat in different ways. Although many of these differences are a product of societal expectations (e.g., men are typically expected to hide their stress), there are in fact some differences in the HPA axis of males and females. Numerous experiments have found that males have a larger cortisol response to stress than females. This difference occurs for both real-world stressors such as exams and laboratory-based stressors such as having to give a speech (Kudielka & Kirschbaum, 2005). As a result, males tend to respond to threats with a rapid expenditure of energy (fight or flight).

Shelley Taylor and her colleagues at UCLA have suggested that whereas men are more likely to react to stress or threats with a fight-or-flight response, women are more likely to have a more social *tend-and-befriend* response (Taylor et al., 2000; Taylor, 2006). This view makes sense if you think about the history of our species. Over the course of our species' evolution, females have had to care for dependent and vulnerable children. Running away from a stressful situation would have required abandoning offspring; getting into a fight risked the possibility of death or injury. Both of these responses would have reduced the likelihood that their offspring would have survived. Instead, it made more sense to seek out stable friendship networks for support during times of stress. Doing so provided comfort, but also the potential for additional resources to help with offspring. This is not to say that women don't have any

instinctive fight-or-flight response or that men have no need to tend and befriend; rather, these researchers are suggesting that there are sex differences in which response is *more likely* to occur.

According to the tend-and-befriend theory, females often respond to stress by seeking out social support networks. Although there are physiological explanations for sex differences in stress responses, we should also remember that cognitive and social factors also influence these behaviours.

Photographee.eu/Shutterstock

The tend-and-befriend reaction may be promoted by the release of **oxytocin**, *a stress-sensitive hormone that is typically associated with maternal bonding and social relationships*. Oxytocin influences a number of behaviours, including the contraction of the uterus when a woman is in labour, romantic attachment, social bonding, trust, wound healing, and orgasm (although not all at the same time; Caldwell & Young III, 2006; Lee et al., 2009). Although oxytocin is clearly involved in a number of behaviours, its role in stress is particularly important. Animal studies have shown that stimulating the release of oxytocin reduces activity in the

sympathetic nervous system (one of the parts of the stress network) and blood pressure (Carter, 1998). In humans, women who are breastfeeding and thus have high levels of oxytocin show lower stress responses to physical and psychological stress (Light et al., 2000). Similar findings were reported in men who were given doses of oxytocin (Heinrichs et al., 2003). And, most relevant to the tend-and-befriend hypothesis, women who receive more frequent hugs from their romantic partners also had higher oxytocin levels and lower stress responses (Light et al., 2005). That's something to think about when studying for exams.

Working the Scientific Literacy Model

Hormones, Relationships, and Health

Listen to the Audio

Social relationships can be a major source of both positive and negative stress, and they can provide a great deal of support during our most stressful times. Given the links between stress and health, it seems reasonable to ask: How do our personal relationships relate to health?

What do we know about hormones, relationships, and health?

Many family events and relationships can be stressful. Almost everyone has argued with their parents or siblings. Holidays and weddings can be fun, but they also involve a lot of planning and, at times, "intense discussion." Sometimes relationships—particularly with close friends or romantic partners—become very difficult and tense, and may even lead to chronic stress responses that adversely affect a person's health. However, other relationships can be quite fulfilling, and can lead to strong social bonds that last a lifetime. These positive relationships have been linked to specific hormonal responses in the body.

Two hormones, oxytocin and vasopressin, are involved in social behaviour and bonding. We previously discussed the role of oxytocin in moderating stress responses, particularly in females. Oxytocin has been shown to inhibit activity in the amygdala, a

brain region involved with fear and threat responses (Radke et al., 2017). It may also prevent the release of cortisol (Heinrichs et al., 2003). Vasopressin also has stress-reducing functions. Like oxytocin, the release of vasopressin is controlled by the hypothalamus and pituitary gland, and affects the levels of stress hormones released by the adrenal gland (Goland et al., 1991). People with high vasopressin levels tend to report better relationship quality with their spouses (Walum et al., 2008). However, oxytocin and vasopressin have health functions that go beyond improving social bonds. Both of these hormones interact with the immune system, specifically to reduce inflammation (Li et al., 2017).

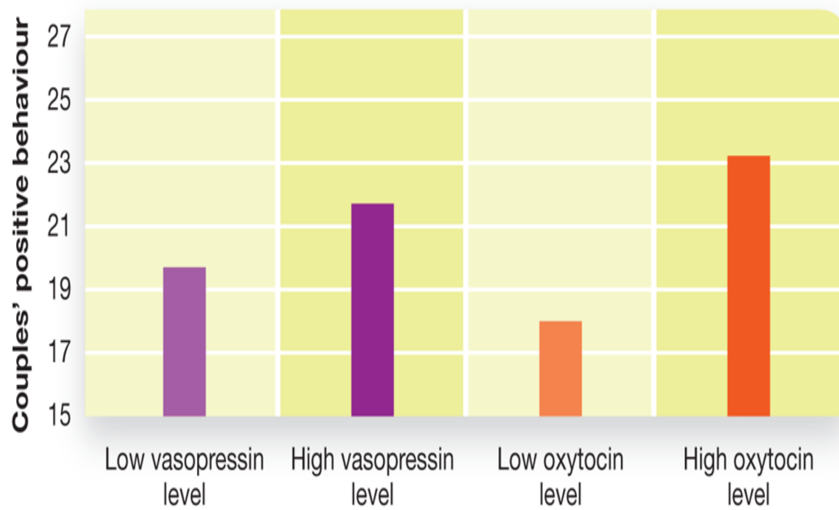
How can science explain connections between hormones, relationships, and health?

A common, if not surprising, method for measuring immunity and health is to see how quickly people recover from a minor wound. In one study, the effect of marital stress on wound healing was tested in a group of 37 married couples (Gouin et al., 2010). Each couple was asked to sit together with no other couples or researchers present and complete a series of marital interaction tasks, including a discussion of the history of their marriage and a task in which both spouses were instructed to discuss something they wished to change about themselves. These interactions were videotaped. The researchers also took blood samples to measure oxytocin and vasopressin levels. Additionally, each participant consented to receiving a suction blister on the forearm, which is a very minor wound created with a medical vacuum pump. It's like a hickey—but a hickey *for science*.

During the marital interaction tasks, those who engaged their partner with positive responses including acceptance, support,

and self-disclosure had higher levels of oxytocin and vasopressin. Those who responded with hostility, withdrawal, and distress had lower levels (Figure 14.7). In addition, the suction blister wounds healed more quickly over an eight-day period in individuals with high oxytocin and vasopressin levels. (Suction wounds heal to 100% within 12 days.)

Figure 14.7 Relationship Quality Is Related to Physiological Responses



Higher oxytocin and vasopressin levels are associated with positive social interactions between married couples.

Source: Republished with permission of Elsevier Science, Inc., from Gouin, J.-P., Carter, C. S., Pournajafi-Nazarloo, H., Glaser, R., Malarkey, W. B., Loving, T. J., et al. (2010). Marital behavior, oxytocin, vasopressin, and wound healing. *Psychoneuroendocrinology*, *35*(7):1082–1090. Permission conveyed through Copyright Clearance Center, Inc.

In another experiment, married couples were given either an intranasal solution of oxytocin or a placebo. They then engaged in discussion about conflict within their marriage. Those who received a boost of oxytocin showed more positive, constructive behaviour during their discussion compared to couples in the placebo group. The researchers also measured cortisol levels from saliva samples obtained from each individual. Those in the

oxytocin group had lower levels of this stress hormone compared to couples in the placebo group (Ditzen et al., 2009).

Can we critically evaluate this evidence?

It might be tempting to conclude that a boost of oxytocin or vasopressin could be the key to marital happiness, stress reduction, and physical health. Although the studies you just read about are related to these important qualities, it is important to avoid oversimplifying what their results mean. Claims that homeopathic oxytocin remedies can make anyone happier and better at love, marriage, sex, and even "mind reading" should be looked at with skepticism. Advertisements for such products are not hard to find. However, scientists are still in the relatively early stages of learning just how oxytocin and vasopressin affect social behaviour in humans, and how they are related to immune system function (Gouin et al., 2010; Macdonald & Macdonald, 2010). For example, researchers have found that high oxytocin levels are also present in people who are experiencing relationship *distress*, which is in direct contrast to the studies previously discussed (Grebe et al., 2017). Related to this, the tend-and-befriend hypothesis predicts high oxytocin levels in people experiencing relationship distress, and the increased oxytocin can fuel the motivation to find positive social encounters outside of the ditressed relationship (Taylor, 2006).

Why is this relevant?

Although these studies were conducted with married couples, the physiological and physical healing benefits of close, positive social relationships extend to romantic relationships, friendships, and family. Procedures for healing physical injury currently focus on repair to damaged areas and preventing infection from setting in. In addition to these critical steps, it appears that managing psychological stress is also important for facilitating recovery

from injury (Gouin & Kiecolt-Glaser, 2011). Exposure to high levels of adversity or trauma early in life, particularly among females, results in genetic modifications that inhibit the brain's ability to use oxytocin (Gouin et al., 2017). This can in turn increase people's susceptibility to physical and mental illness. As we shall see in the next section of this module, stress can also affect a number of other aspects of our physical health.

Stress, Immunity, and Illness

Listen to the Audio

You have likely had the experience of getting sick in the midst of a period of high stress. You are not alone; dozens of experimental and correlational studies have shown, for example, that stress increases the likelihood that people will succumb to the cold virus (Cohen et al., 1998). In fact, one study suggests that final exams—an obvious stressor for students—may be bad for you. In this investigation, medical students provided blood samples during the term and again during the final exam period. Analysis of these blood samples showed reduced immune responses during the high-stress period at the end of the term (Kiecolt-Glaser, 1984). There is a reason this happens: the immune system, which is responsible for protecting the body against infectious disease, has numerous connections with the nervous system, including the stress response systems just discussed (Maier & Watkins, 1998; Selye, 1955). **Psychoneuroimmunology** *is the study of this relationship between immune system and nervous system functioning*.

Psychologists are finding that the stress–illness relationship is a very complex one, involving numerous physiological systems. These investigations are made even more challenging by the fact that the effects of mental stress on physical functioning are diverse. Recall that stress can come in a variety of forms—at the very least, we can divide it into acute and chronic variations. It appears that stress also has dual influences on immunity. Acute stressors tend to activate the immune system, whereas

chronic exposure to stress generally causes suppression of the immune system (Segerstrom & Miller, 2004).

Stress, Personality, and Heart Disease

Listen to the Audio

In addition to making people more prone to catching viruses, high stress levels appear to put people at greater risk for developing **coronary heart disease**—*a condition in which plaques form in the blood vessels that supply the heart with blood and oxygen, resulting in restricted blood flow*. For example, one study followed 12 000 healthy males for a nine-year period and found that men who experienced ongoing stress with their families or at work were 30% more likely to die from coronary heart disease than were men who were not chronically stressed (Matthews & Gump, 2002). Coronary heart disease begins when injury and infection damage the arteries of the heart. This damage triggers the inflammatory response by the immune system—white blood cells travel to affected areas in an attempt to repair the damaged tissue. These cells gather cholesterol and form dangerous plaques, which can rupture, break off, and block blood flow. So how does stress fit into this picture? Stress causes an increased release of those molecules that cause the inflammation that leads to heart complications (Segerstrom & Miller, 2004).

It seems like the link between stress and heart disease should have a simple solution: reduce your stress levels. However, this isn't as straightforward as one might think. The reason is that our stress responses are affected by our personalities. Interestingly, this relationship wasn't discovered by psychologists. Rather, it was noticed by two cardiologists—Meyer Friedman and Ray Rosenman—who were conducting an eight-and-a-half year study of cardiovascular health. As

you might expect, they found that people who were prone to stress had poorer physical health (Friedman & Rosenman, 1959). Importantly, a subset of these patients also had a particular group of personality traits that the researchers labelled as Type A. The **Type A personality** *describes people who tend to be impatient and worry about time, and are easily angered, competitive, and highly motivated*. In contrast, the **Type B personality** *describes people who are more laid-back and characterized by a patient, easygoing, and relaxed disposition* (Friedman & Rosenman, 1974). These studies revealed that people who fall in the Type A category are far more likely to have heart attacks than are Type B people.

This initial finding has been replicated many times, though the correlation between levels of Type A characteristics and coronary heart disease is only moderate. This less-than-strong relationship likely reflects the fact that other factors, not just how a person copes with stress, may further elevate the risk of coronary heart disease. People who have a Type A personality also engage in behaviours that compromise physical health, such as drinking large quantities of alcohol, smoking, and sleeping less than people with a Type B personality. Thus, numerous correlated factors may explain the relationship between Type A personality and risk of coronary heart disease. People with Type A personalities are often successful. However, they are also much more likely to experience heart attacks and strokes than are more relaxed, less hostile individuals.

The distinction between Type A and B personalities has not satisfied all behavioural scientists and physicians. Being quick to anger is a characteristic of Type A individuals, but so is being hyper-motivated to succeed at work. Perhaps there is something more specific about personality that increases the risk for developing heart disease (Strickhouser et al., 2017). More recent research has shown that people who are prone to hostility and anger are at greater risk for developing coronary heart disease (Razzini et al., 2008). Other personality

characteristics linked to coronary heart disease include anxiety and depression (Barger & Sydeman, 2005; Lett et al., 2004). On the other hand, high conscientiousness is related to better self-care, which reduces incidences of conditions such as diabetes (Skinner et al., 2014).

Imagine you have a one-hour break between classes, during which you need to get lunch and also visit one of your professors across campus. When you arrive at your professor's office, you see a line of other students awaiting their turn, and the current occupant is blathering on and on about something completely unrelated to schoolwork. How would you tend to react in this situation? Would you become agitated, angry, resentful, and fidgety? Or would you be more inclined to strike up a conversation with others in line to help pass the time? Your answer will likely depend on various factors—but each of us tends to have a common style of responding to stressful events.

Christopher Futcher/E+/Getty Images

Myths in Mind

Stress and Ulcers

Many of the presumed links between stress and health are oversimplified or misunderstood. People typically associate ulcers—open sores in the lining of the esophagus, stomach, and small intestine—with people working in high-stress jobs, such as police officers or air traffic controllers. The belief that stress causes people to develop ulcers is widespread. In actuality, most ulcers are caused by a bacterium, *Helicobacter pylori*, which can cause inflammation of the lining of various regions of the digestive tract. This bacterium is surprisingly common, and approximately 10% to 15% of people who are exposed to it will develop an ulcer resulting from inflammation. Thus, stress does not cause ulcers, although it can worsen their symptoms. Also, smoking, alcohol, pain relievers, and a poor diet—anything that can irritate the digestive system—increases problems associated with ulcers.

Contrary to popular belief, chronic stress, like that experienced by air traffic controllers, will not cause a stomach ulcer.

Photodisc/Getty Images

Stress, Food, and Drugs

Listen to the Audio

Stress influences heart functioning in other, indirect, ways as well. Survey research has consistently shown that people are drawn toward sweet and fatty foods when they are stressed (Oliver & Wardle, 1999; Steptoe et al., 1998). Laboratory-based studies have shown similar trends. In one experiment, female participants were given stress-inducing tasks to complete, including solving a visuospatial puzzle, performing math calculations, and giving a speech in front of what they thought was an audience seated behind a one-way mirror. The women who had the highest levels of the stress hormone cortisol ate more sweet, high-fat snacks than did the less-stressed women (Epel et al., 2001). The relationship between stress and unhealthy food extends to other species as well. Low-status females in a colony of monkeys are often bullied and harassed by high-status females. Researchers have noted that the low-status females ate more banana-flavoured pellets than their social superiors (Wilson et al., 2008). Interestingly, similar results were found when monkeys had the opportunity to self-administer cocaine; the subordinate monkeys pressed a lever much more often than the dominant monkeys who presumably had less stress (Morgan et al., 2002).

Obviously, overeating unhealthy food (or doing cocaine) is not a good long-term solution to stress. So, why do some people (and monkeys) use food and drugs to deal with stress? Although it is possible that these substances directly affect the hormones and brain areas associated with stress, most scientists agree that food (and drugs) influence the brain's

dopamine reward system (see Modules 5.3 and 6.2). Some research suggests that chronic stress suppresses the reward system (so stressed people would find less joy in things). It is possible that eating rewarding foods increases the activity in this system so that it is closer to normal levels (Adam & Epel, 2007; Dallman et al., 2003). Additionally, as discussed in Module 11.1, people who are stressed are mobilizing the body's resources in case action is required; eating fatty and sugary foods provides the body with extra calories *in anticipation* of the person having to use additional energy to deal with a stressor.

Stress, the Brain, and Disease

Listen to the Audio

Although stress is often linked to cardiovascular problems like heart attacks and strokes, its negative effect on the immune system makes stress a factor in other conditions as well. Acquired immune deficiency syndrome (AIDS) is a disease caused by infection with the human immunodeficiency virus (HIV). This disease saps the immune system's ability to fight off infections to such an extent that even conditions that are relatively harmless to most of the population can be devastating to an individual with AIDS. Patients in industrialized countries with more medical options have a better prognosis than those living in impoverished areas. Retroviral therapies have greatly increased the longevity, health, and overall quality of life of patients. However, people who are HIV-positive need regular vaccination treatments. Unfortunately, stress impedes the body's ability to respond to vaccinations. In turn, studies have shown that those who experience serious emotional distress are less responsive to HIV treatments. Stress-induced elevation of the neurotransmitter norepinephrine—which is involved in emotional arousal and stress responses—can also worsen the condition of the various illnesses associated with AIDS. Patients who have elevated activity of the autonomic nervous system are slower to respond to antiretroviral therapies, which increases their risks of developing certain types of cancer such as B-cell lymphoma (Cole et al., 1998).

Researchers are also finding numerous links between psychosocial factors and cancer progression (Antoni & Lutgendorf, 2007). Several factors,

such as the type of cancer and an individual's age, account for why some people rapidly succumb to cancer while others are able to overcome this disease. But stress levels also affect the progression of cancer. Why is this? It appears that norepinephrine supports cancer cell growth, and that cortisol magnifies this effect. Hormones from the autonomic nervous system stimulate cells that reside in tumours, which ultimately results in growth and proliferation of these masses (Antoni et al., 2006). Thus, when someone experiences stress, the autonomic nervous system and HPA axis naturally respond, but their reactions compromise how well the individual can fight the disease.

For many people, stress levels can be changed and the course of a disease such as cancer can be slowed. For example, individuals who have undergone assertiveness training and learn anger management techniques show reduced autonomic activity and hormonal activity associated with the HPA axis (Antoni et al., 2007). Also, those who are optimistic, cope by using humour, and have a positive outlook on the disease (and thus less stress) show physiological benefits such as greater immune responses (Lutgendorf et al., 2007). These studies show us that how we mentally react to the stressors in our lives can dramatically influence how our body responds to serious illness. In the next module, we will discuss how you can draw from psychology research to improve your ability to cope with stress. Doing so will make you happier—and healthier.

Module 14.2 Summary

Listen to the Audio

14.2a Know . . . the key terminology associated with stress and illness.

Review Module 14.2

Start Over Swap

0/12 REVIEWED · 0 MASTERED

oxytocin

Previous Next Got It!

14.2b Understand . . . the physiological reactions that occur under stress.

When a person encounters a stressor, the hypothalamus stimulates the sympathetic nervous system to act, triggering the release of epinephrine

and norepinephrine from the adrenal medulla. This reaction is often referred to as the fight-or-flight response. Another part of the stress response system is the HPA axis, in which the hypothalamus stimulates the pituitary gland to release hormones that in turn stimulate the adrenal cortex to release cortisol, which prepares the body to deal with stressful situations.

14.2c Understand . . . how the immune system is connected to stress responses.

Chronic release of cortisol suppresses the immune system, leaving people more vulnerable to illness and slowing recovery time from illness and injury.

14.2d Apply . . . a measure of stressful events to your own experiences.

Apply Activity

To complete this activity, look at Table 14.2. Using the values next to each stressful event listed, add up the numbers that apply to your experiences and compute your total stress score. Holmes and Rahe (1967) found that a score of 300 or more puts people at significant risk for illness, while a score of 150 to 299 puts people at a moderate risk.

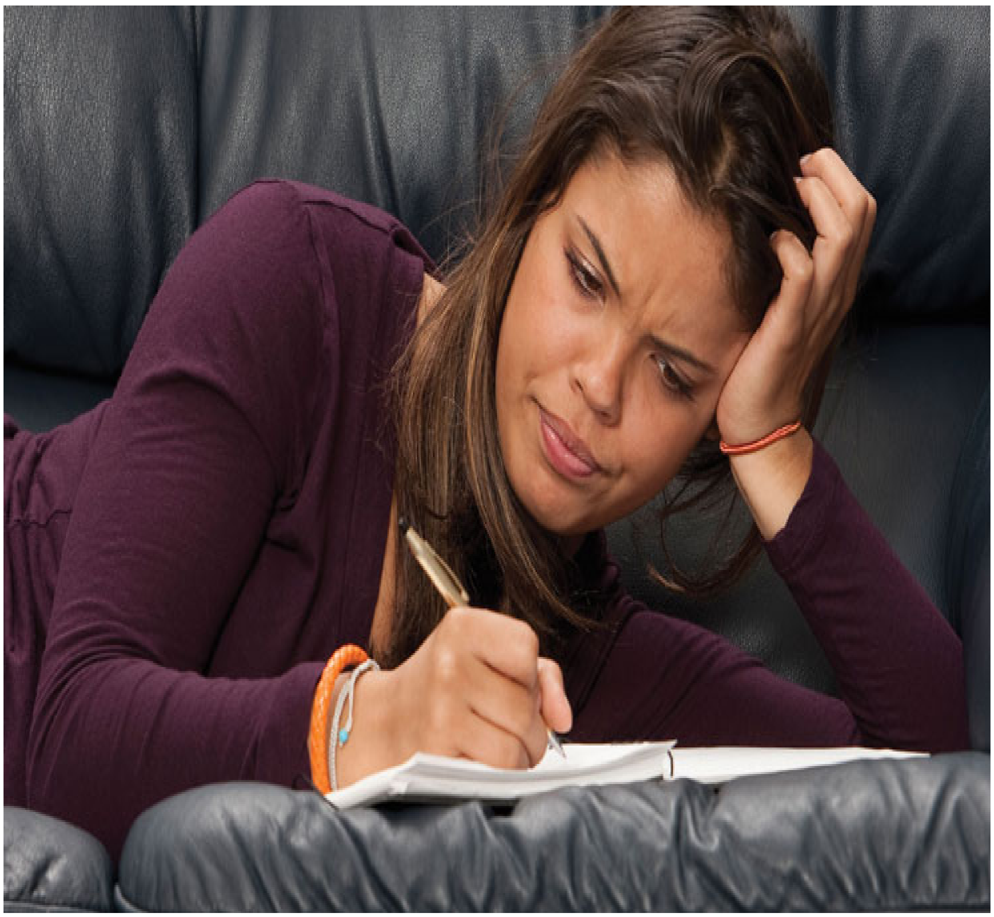
Years later, Renner and Mackin (1998) developed a similar scale for college and university students based on data gathered from a sample of 257 undergraduate students (range: 17–45 years; mean: 19.75 years). Do an internet search for Renner and Mackin's College Undergraduate Stress Scale and calculate your own stress score. They reported an average stress score of 1247 (standard deviation: 441), with scores ranging from 182 to 2571. How do you compare with their sample?

14.2e Analyze . . . the claim that ulcers are caused by stress.

Ulcers are damaged areas of the digestive tract often caused by infection with the bacterium *Helicobacter pylori*. Stress and other factors, such as diet and alcohol consumption, can worsen the condition of ulcers, but stress alone does not cause them.

Module 14.3 Coping and Well-Being

Listen to the Audio



John Lund/Stephanie Roeser/Glow Images

Learning Objectives

14.3a Know . . . the key terminology associated with coping and well-being.

14.3b Understand . . . how control over the environment influences coping and outlook.

14.3c Understand . . . positive and negative styles of coping.

14.3d Apply . . . your knowledge of the beneficial effects of optimism to help you reframe stressful situations as positive opportunities.

14.3e Analyze . . . whether activities such as relaxation techniques and meditation actually help people cope with stress and problems.

What is the best way to cope with a personal disaster, such as losing your job? Writing about how the event makes you feel may not seem like a priority, but according to psychologist James Pennebaker, it may be one of the best strategies for coping and regaining the emotional resources needed to move on. Pennebaker, a leading researcher on the psychological benefits of writing, decided to intervene when a local computing and electronics firm laid off 60 professional workers. All he asked the workers to do was to write, but their instructions on how to write were different: Half the volunteers were randomly assigned to write about their "deepest thoughts and feelings surrounding the job loss, and how their lives, both personal and professional, had been affected" (Spera et al., 1994, p. 725). In contrast, the control group members were told to write about their plans for the day and how they planned to find another job, which is much less personal and emotional. After a month of weekly 20-minute writing sessions, the group members who were writing about their emotions were getting hired much more frequently than the control group members. The participants were randomly assigned to the two groups, so the differences between the groups can be traced to the writing rather than to pre-existing personality differences. Similar methods have been used in Pennebaker's studies of first-year university students, people grieving the loss of a loved one, and other groups experiencing stressful

transitions. The result was the same each time—group members who wrote meaningful narratives of their emotions and thoughts came out ahead, not just in terms of mental health, but also physically and in their performance at work or school.

This module is designed to help you. In it, you will read about some widely used solutions for coping with stress and behavioural methods that may potentially help in improving health. We will also discuss some topics that might be less familiar, but may prove useful in how you cope with stress and negative events. Finally, we will discuss how stress and successful coping are closely related to your sense of control.

Coping

Listen to the Audio

Although understanding how stress works—both physically and mentally—is important, it is the ability to cope with that stress that will dictate whether or not you are happy. **Coping** *refers to the processes used to manage demands, stress, and conflict*. Coping strategies can include *problem-focused coping* and *emotion-focused coping*. Some of us approach a problem or stressor, such as large monetary debt or a setback at work, by taking a problem-solving approach. In other words, we cope by defining the problem and working toward a solution. If you are stressed out by school demands, you could address the problem by setting up a study schedule, dropping a course, or finding a tutor, among many other possible solutions. However, there are times when it is more important to focus on the emotional effects of a stressor than on attempting to find an immediate solution to a problem—in fact, not all stressors are brought about by problems that have identifiable solutions. For example, imagine that your beloved family pet has passed away. In such a situation, you obviously cannot make a list to deal with your grief; however, you *can* find ways to reduce the negative effects your emotions are having, both on yourself and on others. Neither of these styles of coping is necessarily superior to the other—their suitability depends on the nature of the problem (Folkman & Lazarus, 1980). In many instances, both problem-focused coping and emotion-focused coping are used to deal with a stressor.

Of course, not all coping techniques actually help; some may simply replace one problem with another. For example, some people turn to alcohol or drugs to temporarily avoid feelings of stress, and some turn to food. Unfortunately, sitting in front of the television and eating a litre of Häagen-Dazs ice cream from the container is not a healthy method of coping. In this section, we will examine both the positive and negative methods of coping, and then describe several techniques that can be used to improve your well-being.

Positive Coping Strategies

Listen to the Audio

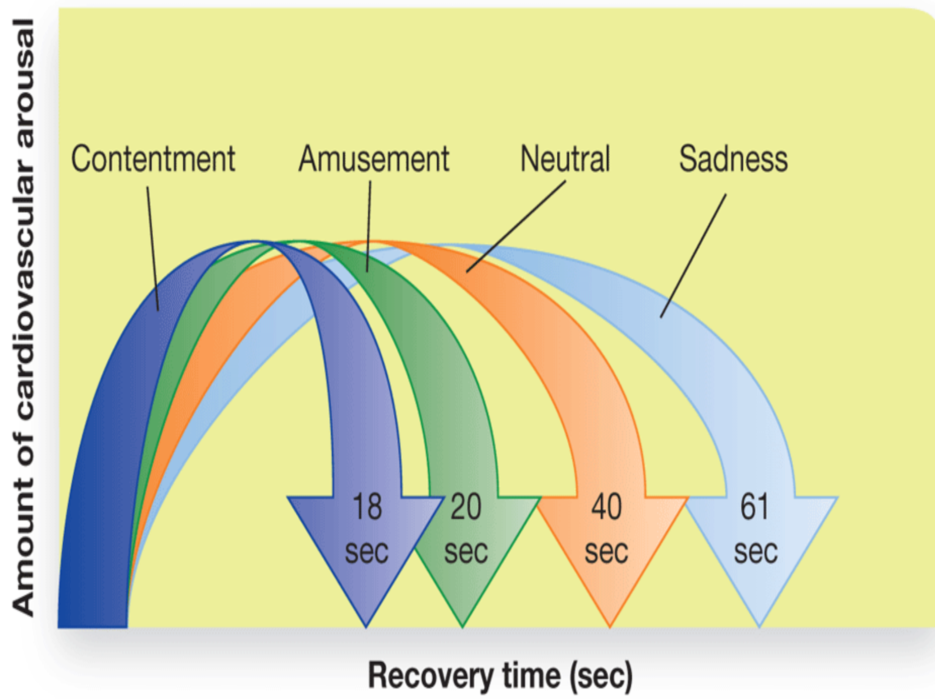
Psychology may have a reputation for focusing on the negative, including how damaging stress can be. In reality, psychologists also study what makes people thrive, even in the face of extreme stress. This area of study, **positive psychology**, *uses scientific methods to study human strengths and potential*. Research in this area has identified numerous adaptive and constructive ways in which people cope with problems. These researchers have found that one of the most powerful tools for coping is also one of the simplest: focusing on positive emotions.

Although it may seem difficult to imagine experiencing positive emotions during times of stress, doing something simple like watching a funny movie can actually help you cope with stress and negative life experiences. Barbara Fredrickson and her colleagues at the University of North Carolina (Chapel Hill) have shown that positive emotions can affect how we perceive and think about the world. For example, these researchers have shown that a negative mood narrows your focus of attention so that you attend to a small part of your environment, whereas positive moods cause the focus of your attention to expand (Fredrickson & Branigan, 2005). Other scientists have demonstrated that positive moods can also increase a person's creativity. In one experiment, participants were shown groups of three words (e.g., *falling, actor, dust*) and were asked to find a word that related to all three items (e.g., *star*). Individuals in the positive mood condition scored higher than other participants (Isen et al., 1987). This increase in flexible thinking is crucial

during coping, as it would help people experiencing negative emotions reframe their stressors into something less upsetting.

Although the effects of positive emotions on our ability to perceive and think are interesting, the most stunning effect of positive emotions is their effect on our autonomic nervous system. When most of us watch a scary movie, our heart rates increase as we experience fear. Then, after a little while, our heart rates return to normal. But the speed at which this recovery occurs can be influenced by positive emotions. Researchers have found that when participants watched positive films after seeing a scary movie clip, their heart rate returned to normal faster than when participants viewed a sad or neutral film (see Figure 14.8). The positive emotions seemed to defuse the effects of the negative emotions, thus decreasing the amount of damage that stress and negative emotions can have on the body (Fredrickson & Levenson, 1998). Because positive emotions allow people to broaden their thought processes and to build new intellectual, social, and physical resources, these results are now described as the *broaden-and-build theory* of positive emotions (Fredrickson, 2001, 2003).

Figure 14.8 Positive Moods and Recovery from Negative Emotional Events



Research shows that positive moods speed up a person's recovery from negative events. In this study, viewing a video depicting positive emotions (amusement or contentment) caused heart rates to return to normal levels faster than a neutral or sad video (Fredrickson & Levenson, 1998).

Source: Data from Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition & Emotion*, *12*, 191–220. Fig. 3, p. 205.

Optimism and Pessimism

Listen to the Audio

Closely linked to positive emotions is the concept of **optimism**, *the tendency to have a favourable, constructive view on situations and to expect positive outcomes*. People who are optimistic tend to initially perceive situations in a positive way and are also more likely to find positive elements in situations. In contrast, **pessimism** *is the tendency to have a negative perception of life and expect negative outcomes*. These individuals often have what is known as **pessimistic explanatory style**, *which is the tendency to interpret and explain negative events as internally based (i.e., as being due to that person rather than to an external situation) and as a constant, stable quality* (Burns & Seligman, 1989). For example, a laid-off employee who struggles to find a job may attribute the problem to his perceived inability to network properly rather than to the fact that it is tough to find jobs in his field. Pessimism is also often linked with **negative affectivity**, *the tendency to respond to problems with a pattern of anxiety, hostility, anger, guilt, or nervousness*. These negative emotions make it difficult for these individuals to choose an appropriate coping strategy for a given problem (DeLongis & Holtzman, 2005; O'Brien & DeLongis, 1996). For instance, someone with high levels of negativity may deal with a difficult breakup by socially withdrawing from others and by becoming angry and resentful. Such responses also make it more difficult for others to provide social support.

As you might expect after reading the previous section, optimism is correlated with better physical health than pessimism. For example,

scientists have shown that women who tend toward pessimism and test positive for the HPV virus (a papilloma virus known to cause cervical cancer) have lower counts of white blood cells that fight disease than do optimistic women with the HPV virus. Long-term studies show similar effects of optimism. In the U.S. Veterans Affairs Normative Aging Study involving a large cohort of male participants, optimists had a lower incidence of coronary heart disease than did pessimists (Kubzansky et al., 2001). Similarly, researchers at the Mayo Clinic administered personality tests assessing optimism and pessimism to patients who came into the clinic for general medical issues during the 1960s. Thirty years later, the data on optimism and pessimism were compared to patient survival. The researchers found a 19% increase in mortality risk in people who were consistently pessimistic (Maruta et al., 2000). Perhaps a good attitude does more than help individuals cope emotionally with illness; perhaps it actually helps them overcome it.

Although these studies present a convincing case for optimism, there is an alternative explanation for the results: Optimists and pessimists may simply have had different lifestyles. One of these other lifestyle variables (e.g., diet) could potentially explain the health differences between optimists and pessimists. In order to control for this possibility, a group of U.S. researchers conducted longitudinal (long-term) studies of a group of females with nearly identical lifestyles: nuns. The Nun Study, as it is now known, was exceptional in that it allowed researchers to examine how personality factors such as optimism and pessimism affected people over the course of their lifetime while controlling for variables such as diet, work demands, and stress. As part of this study (which is part of a longitudinal study about factors leading to Alzheimer's disease), the researchers examined the handwritten autobiographies of 180 nuns. These documents were written by the nuns when they were entering the order in their early to mid-twenties. The emotional content of the

autobiographies was coded by the researchers to see if positive emotions predicted how long the nuns lived. Here are two excerpts from the study:

> Sister 1 (low positive emotion): I was born on September 26, 1909, the eldest of seven children, five girls and two boys. . . . My candidate year was spent in the Motherhouse, teaching Chemistry and Second Year Latin at Notre Dame Institute. With God's grace, I intend to do my best for our Order, for the spread of religion and for my personal sanctification.
>
> Sister 2 (high positive emotion): God started my life off well by bestowing upon me a grace of inestimable value. . . . The past year which I have spent as a candidate studying at Notre Dame College has been a very happy one. Now I look forward with eager joy to receiving the Holy Habit of Our Lady and to a life of union with Love Divine. (Danner et al., 2001, p. 806)

The researchers found a strong correlation between positive emotions during young adulthood and the longevity of the nuns—people who were more positive during their twenties lived longer than less positive people (Danner et al., 2001). Similar results have been found with less-controlled populations (Maruta et al., 2000; Peterson et al., 1998), suggesting that the results of The Nun Study are due to optimism and positivity, not to an act of divine intervention.

Resilience

Listen to the Audio

Thus far, we have discussed a number of factors that can reduce the effects of stress and promote well-being. However, there are times when negative life events are unavoidable. As you have likely noticed in your own life, individuals differ in their ability to bounce back from events such as disaster, disease, or major loss. This trait is known as **resilience**, *the ability to effectively recover from illness or adversity*. Resilient people tend to have one or more factors stacked in their favour. Financial and social resources, opportunities for rest and relaxation, and other positive life circumstances contribute to resiliency. Even so, amazing stories of resiliency can be found among individuals living with unimaginable stress. Thus, the personality and emotional characteristics discussed earlier are also important contributors to resiliency in the face of adversity.

One amazing example is that of Viktor Frankl, an early- and mid-20th-century Austrian psychiatrist. Frankl was already an influential physician and therapist when he, his wife, and family were forced into concentration camps during World War II. Frankl found himself in the role of helping people adjust to life in the concentration camp, even while he himself struggled to survive each day. He encouraged others to tap into whatever psychological resources they had left to cope with very bleak circumstances. Frankl found that one of the most critical parts of surviving in these camps was finding some sort of meaning in life. For some, this could be the desire to reunite with their family when the war

eventually ended. For others, it was a love of poetry (astoundingly, some prisoners were able to write poetry in the concentration camps). But if a prisoner seemed to lose this sense of meaningfulness in his life, Frankl could tell that this prisoner would soon die. As Frankl later noted, "Despair equals Suffering minus Meaning" (Gelman et al., 2000, p. 625). A key challenge, then, was to maintain this sense of meaningfulness so that people had a purpose in their lives. Doing so allowed them to cope and remain resilient while witnessing terrifying events. Eventually Frankl's wife and parents were deported to different concentration camps, where they were murdered. Despite his own enormous losses, Frankl continued helping others to cope and find solace under the worst of circumstances (Frankl, 1959).

Psychologists have long focused on the negative outcomes of stress, but stories such as Frankl's demonstrate that stress and trauma can also lead people to recognize how strong they really are. In fact, psychologists describe the phenomenon of **post-traumatic growth**, *the capacity to grow and experience long-term positive effects in response to negative events* (Tedeschi & Calhoun, 2004). It happens in response to events such as automobile accidents, sexual and physical assault, combat, and severe and chronic illnesses. Individuals who experience post-traumatic growth often report feeling a greater sense of vulnerability, yet over time develop an increased inner strength. They also report finding greater meaning and depth in their relationships, a greater sense of appreciation for what they have, and an increased sense of spirituality (Tedeschi & Calhoun, 2004).

Post-traumatic growth is not an alternative reaction to post-traumatic stress. Rather, the two conditions occur together. Clinicians recognize that the growth occurs during the process of coping, not because of the event itself. Often a clinical psychologist trained in working with trauma victims helps facilitate the growth process and assists the individual in finding the interpersonal and social resources needed for healing. Some

of these resources include medications and some form of counselling. It is also becoming increasingly common for people to use other techniques to reduce responses to stress and negative events, including meditation and yoga.

Meditation and Relaxation

Listen to the Audio

Many people report significant benefits by using relaxation and meditation techniques to cope with stress and life's difficult periods. Both techniques are designed to calm emotional responses as well as physiological reactions to stress. **Meditation** *is any procedure that involves a shift in consciousness to a state in which an individual is highly focused, aware, and in control of mental processes*. However, to say "meditation" is a bit simplistic, as meditation has many different techniques and is practised, in some form, in almost every known culture.

In some types of meditation, the individual focuses his or her attention on a chosen object, such as a point on the wall or a physical sensation like the feeling related to breathing. This technique is known as *focused attention (FA) meditation*. When distracting or negative thoughts enter into their awareness and interfere with meditation, people are taught to accept these thoughts in a nonjudgmental manner, and to then nudge their attention back to its original focus (Lutz et al., 2008). Although this technique is initially quite difficult, over time people become quite good at maintaining their attention on their chosen object.

A second type of meditation is *open monitoring (OM) meditation*. This technique also uses focused attention to train the mind and to reduce the influence of distractions. After initial training with FA, people can transition into the use of OM styles of meditating. Here, meditators pay attention to moment-by-moment sensations without focusing on any

particular object (Cahn & Polich, 2006). A key feature of OM is to attempt to experience each sensation intensely, examining its rich sensory properties and emotional characteristics in great depth; however, these sensations should not become the sole focus of attention, preventing the meditator from responding to other sensations.

The idea that the feelings of happiness and relaxation associated with meditation are due, in part, to us becoming more attentive to the present moment and less attentive to our own "stories" has found some support in research performed at the University of Toronto. Norm Farb and colleagues (2007) used fMRI to examine brain activity in trained meditators and a control group of non-meditators. Participants were asked to take one of two perspectives while reading lists of positive (e.g., *charming*) and negative (e.g., *greedy*) words. During half of the experiment, participants were asked to use a Narrative Focus, which required them to think about what each word meant and how it related to them. During the other half of the experiment, participants were asked to use an Experiential Focus, which required them to pay attention to their thoughts and bodily reactions to the words as they happened, but without any judgment or elaboration. If they found themselves distracted by any memories or thoughts inspired by a word, they were to calmly return their attention to the present moment. The results were intriguing: During the Experiential Focus condition (which is quite similar to a meditative state), trained meditators showed a larger decrease in activity in areas of the frontal lobes related to "the self" (the medial prefrontal cortex) than did novices. They also showed increased activity in areas related to the perception of their bodily states. These results suggest that meditation does in fact help us separate ourselves from our own narratives and live in the present moment.

Given that numerous other studies have shown that meditation leads to decreased levels of anxiety (Chen et al., 2012; Hoffman et al., 2011), it is

possible that redirecting attention away from our own self-focused thoughts might improve our ability to be happy. Additionally, meditation has been shown to be very effective in reducing blood pressure, which decreases the likelihood of experiencing long-term problems with hypertension and cardiovascular disease (Levine et al., 2017). Taken together, research suggests that meditation can be used as a method of coping with stress and negative emotions and promotes healthy and compassionate behaviour (Condon, 2019).

Mindfulness-based stress reduction (MBSR) *is a structured relaxation program based on elements of mindfulness meditation*. The primary goal of MBSR is to help people to cope and to relax by increasing the link between the body and mind. A common meditative technique used in MBSR is a body scan in which participants pay attention to the sensation of their toes, then their feet, ankles, calves, and so on. By attempting to focus on bodily sensations for 15 to 20 minutes, the participants engage in a great deal of attentional control; if the person's mind wanders, they are simply asked to bring it back to the body scan without judging themself for the slip-up. During these relaxation exercises, participants are instructed to recognize and become aware of any emotions they may experience, but to then let them go so that the emotion is not part of their identity. Studies using MBSR have found that it reduces stress (Baer et al., 2012) and increases a sense of meaningfulness in life (Dobkin, 2008). Not surprisingly, MBSR also leads to increased brain activity in the insula, a brain area related to perceiving bodily sensations; this area is involved with a person's ability to focus on the present moment (Farb et al., 2013). The many forms of meditation and mindfulness practices are related to measurable changes in brain structure and functionality (Tang et al., 2015).

Altered brain activity has also been found after people learned a complex form of meditation called *integrated mind–body training (IMBT)*. This

technique, developed from traditional Chinese medicine, involves a combination of relaxation and posture correction, as well as instructions for heightening awareness of your own body (Tang, 2011). Similar to MBSR, this technique has been shown to enhance the control of attention (Tang et al., 2007). IMBT has also been linked to an increased ability to control bodily physiology. In one study, researchers compared participants who had completed either five days of IMBT or five days of a simpler relaxation training program. The IMBT group showed lower heart rates, breathing rates, and skin conductance responses (a measure of stress) than did the relaxation training group. These differences appear to be due to activity in a region of the medial (middle) prefrontal cortex called the anterior cingulate gyrus. This area is involved in controlling attention as well as in some emotional responses. In this study, activity within the anterior cingulate was associated with the participants' increased control over parasympathetic nervous system responses. The increased parasympathetic activity accounted for the heightened sense of relaxation experienced while meditating (Tang et al., 2009). Interestingly, later studies showed a strengthening of the white-matter connections between the anterior cingulate and emotional structures in the base of the brain (Tang et al., 2010), suggesting that IMBT can change how different neural regions interact.

Meditation, mindfulness, and yoga have become widespread practices for promoting physical and mental health among North Americans.

Tyler Olson/Shutterstock

Although meditation does appear to have a number of health benefits, training procedures like MBSR and IMBT might not be for everyone. However, there is a relaxation technique that many people in your class likely already perform: yoga. According to various organizations, approximately 1.5 million Canadians regularly practise yoga (in one of its many forms). Yoga involves directed breathing while participants move their bodies into specific poses. This voluntary breathing can influence activity in the parasympathetic nervous system, leading to a decrease in emotional arousal (Sovik, 2000). Consistent with this view, U.S. college students who performed directed breathing had lower levels of physical and mental stress than did control participants (Cappo & Holmes, 1984). Yoga may also help your immune system; when compared to people in a simple relaxation condition (nature walks and soft music), people who performed yoga had greater changes in gene expression in the immune cells circulating in the bloodstream (Qu et al., 2013). Long-term

practitioners of yoga have increased connectivity between the frontal cortex and the circuitry involved in emotional responding, which supports the hypothesis that practices such as yoga (and meditation) help establish top-down control of attentional and emotional responses (Hernández et al., 2018).

Thus, scientific studies of meditation and relaxation training in all their forms appear to confirm their health benefits, and are also bringing us closer to understanding precisely *how* these changes to the brain and body help us cope with stress and negativity.

Psych@

Church

Stress-reduction techniques like mindfulness are sometimes associated with spiritualism, as many arose as part of different Buddhist traditions. However, a belief in a higher power is not a requirement of these techniques. In contrast, many people use religion as their primary coping mechanism during stressful situations, both large and small. They may use any combination of religious practices, depending on the specific nature of the faith: prayer, meditation, religious counselling, and social support from family and congregations. All of these efforts can provide strength and comfort during difficult times, and they may also be associated with greater overall happiness. Many psychologists have become increasingly curious about the possible health benefits associated with religion and spirituality. Numerous studies have found that people who are very religious and are actively engaged with religious practices do, in fact, live a bit longer than do people who are less

religious or non-religious (McCullough et al., 2000). An analysis of obituary information estimated that religious affiliation adds about four years to a person's life (Wallace et al., 2019).

A hasty interpretation of these results might lead one to conclude that religion causes people to live longer—that the experiences of prayer and attending a house of worship lead to greater longevity. However, the studies in this area actually produce correlational, not experimental, data—psychologists cannot randomly assign people to be religious or not. Consequently, we must consider alternative explanations. For example, lifestyle factors are also at play. Younger and older people of Muslim, Jewish, or Christian faith are more likely to engage in healthy behaviours, including wearing seatbelts, visiting the dentist, and avoiding both the consumption of alcohol and cigarette smoking (reviewed in McCullough & Willoughby, 2009). Religions also tend to have negative views of criminal activity, drug abuse, and risky sexual activity. Thus, the increased longevity is probably related to the greater self-control and self-regulation that are characteristic of many religious belief systems.

Generally, people who are religious show greater well-being and lower levels of depression (Smith et al., 2003). The determination of whether religion protects people from depression depends on the point of view taken, however. People who cope with problems using positive aspects of religion (e.g., treating other people with compassion and kindness, as well as collaborating with others in solving problems) are less prone to depression than religious people who adopt negative appraisals of their problems and concerns, such as viewing problems as a result of punishment by a

wrathful God (Ano & Vasconcelles, 2005; McCullough & Willoughby, 2009).

Exercise

Listen to the Audio

Relaxation training and religious study both require discipline; individuals must follow instructions or teachings in a fairly consistent manner. Staying in good physical condition requires similar devotion, and also produces considerable physical and psychological benefits. However, even short bursts of exercise can be useful. For example, researchers in Germany asked university-student participants either to do all-out sprints, to jog, or to do nothing. The students who sprinted were able to learn 20% more items on a vocabulary list than the students who jogged or were inactive (Winter et al., 2007). Why did this occur? Perhaps the sprinters were more motivated than the others. This explanation sounds plausible, but the researchers randomly assigned healthy participants to the three groups—so there should not be anything inherent to the sprinter group that would lead them to learn more words. It appears that the type of exercise they engaged in led to increased cognitive performance. Which physiological processes might account for the cognitive edge the sprinters gained from their intense physical activity? The researchers discovered that the students who engaged in intense exercise had increased levels of dopamine, epinephrine, and **brain-derived neurotrophic factor (BDNF)**—*a protein in the nervous system that promotes survival, growth, and the formation of new synapses*. Cardiovascular exercise also provides immediate benefits in cognitive processing speed, again as measured in university-aged students (Hillman et al., 2003). But, these immediate benefits of exercise are not limited to younger people. When sedentary adults between 60 and 85 years of age take up weekly

exercise, they show improved brain functioning and cognitive performance (Hillman et al., 2008; Kramer et al., 1999).

Rigorous exercise has positive effects on the brain and on our cognitive abilities, making it well worth the time and effort.

shock/Fotolia

One important issue to address is whether these short-term effects translate into lifelong cognitive benefits from exercise. Results from long-term studies indicate that a lifestyle that includes regular exercise helps preserve cognitive function and the brain systems that support it (Raichlen & Alexander, 2017). Researchers have found that older people who are at genetic risk for developing Alzheimer's disease and who show cognitive impairments can slow the rate of memory decline by exercising (Lautenschlager et al., 2008; Wang & Holsinger, 2018). It appears that levels of brain chemicals such as BDNF are boosted by exercise, which helps explain the changes in the brain that account for the cognitive benefits. Furthermore, exercise supports the development of new nerve cells in the hippocampus, a critical area for memory and cognitive activity

(van Praag, 2008). Together, these studies tell us that the benefits of exercise go far beyond helping you look good.

Review How Do You Cope with Stress?

Are you an optimist or a pessimist? Complete the following scale to find out. Once you see how your personality compares to others, you may want to reread the section of this module on optimism and pessimism to better understand the implications for your health.

1. In uncertain times, I usually expect the best.

- Strongly Disagree
- Moderately Disagree
- Neither Agree nor Disagree
- Moderately Agree
- Strongly Agree

2. If something can go wrong for me, it will.

- Strongly Disagree
- Moderately Disagree
- Neither Agree nor Disagree
- Moderately Agree
- Strongly Agree

Previous Next

Source: Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology*, 4(3), 219-247.

Perceived Control

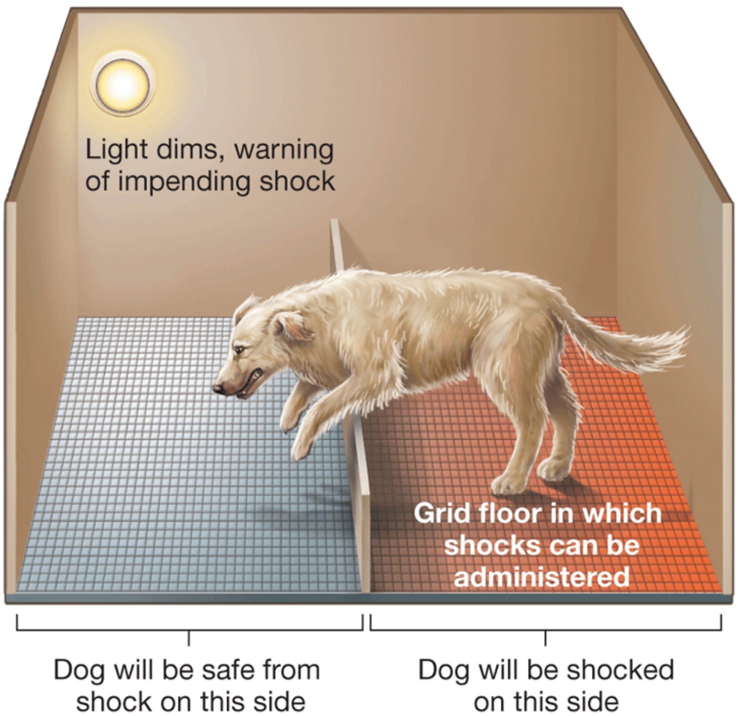
Listen to the Audio

As Dr. Pennebaker's story from the beginning of this module illustrates, the most stressful of circumstances are the ones that people have little or no control over. For example, children who reside in abusive homes have no control over their circumstances, nor do the victims of natural disasters. Each situation can result in people acquiring a sense that their behaviour has little effect on external events.

Laboratory experiments have demonstrated the negative impact that a lack of control has on health and behaviour. A classic example comes from work on avoidance learning in dogs conducted in the 1960s by Martin Seligman and his colleagues (Seligman & Maier, 1967). In this study, dogs received electrical shocks while strapped into a harness. Half of the dogs learned to press a panel in order to escape the shock, thus providing them some control over their stressor. The other half of the dogs received the same number of shocks as the first group, but had no control over when the shocks would occur. After a delay, each dog was placed in a device known as a shuttle box, consisting of two small areas separated by a low divider that the animal could easily jump across (see Figure 14.9). On each experimental trial, a light in the shuttle box was dimmed before the section of the box that the animal was standing on became electrified, thus providing a shock similar to the one experienced in the earlier part of the study. Through trial and error, animals that were in the controllable stress condition learned that they could jump over the divider to the other side of the shuttle box to get away from the shock.

After a few trials, this behaviour occurred immediately after the warning tone was presented, which allowed them to avoid the shock altogether. In contrast, the dogs that had experienced the uncontrollable shocks had difficulties learning to escape. Instead, they would lie down, whine, and appear resigned to receive the shock. This finding was described as **learned helplessness**—*an acquired suppression of avoidance or escape behaviour in response to unpleasant, uncontrollable circumstances*.

Figure 14.9 The Learned Helplessness Procedure



In Seligman and Maier's study, dogs that could avoid a painful shock would quickly learn to do so. Conversely, dogs that initially learned they could not avoid a shock remained passive when the opportunity to do so was given. The acquired failure to avoid or escape unpleasant circumstances that are perceived as uncontrollable is referred to as learned helplessness.

Later studies provided some interesting insights into the behavioural and brain bases of learned helplessness, with some potentially important

implications for how humans respond to stress (Maier & Seligman, 2016). Researchers found that stress responses involve nuclei in the brainstem as well as the ventral (lower) regions of the frontal lobes. When a stressful event is controllable (e.g., being shocked but having a way to escape), the brainstem produces a stress response such as increased heart rate and blood pressure; however, this response is then inhibited by the frontal lobes (Amat et al., 2005). When a stressful event is not controllable, the brainstem provides a stress response without being inhibited. This finding suggests that the degree to which a person *perceives* a stressor to be controllable will influence whether the stress response will be inhibited, and whether the person will experience an event as being stressful.

The important point about learned helplessness is that the animal, or person, *learns* that their actions cannot remove the stress in one situation (e.g., the harness) and then *generalizes* that helplessness to other situations (e.g., the shuttle box). This is similar to the thought processes of some people with depression. People with depression are prone to hold beliefs that their actions have no influence on external events, and that their environment and circumstances dictate outcomes. Learned helplessness also has similarities to anxiety disorders; namely, increased nervousness and a feeling of being unable to escape a stressor (Maier & Watkins, 2005). Clearly, both aspects of learned helplessness can negatively affect mental and physical well-being. This phenomenon shows that the perception of control can have a dramatic effect on our ability to cope. Without it, many humans and some nonhuman species will endure pain and stress rather than initiating ways to avoid or escape it.

Working the Scientific Literacy Model

Compensatory Control and Health

Listen to the Audio

The idea of a random world in which people lack personal control over events can be discomforting. For example, hurricanes and tornados are often referred to as "acts of God," rather than the result of an unfortunate confluence of meteorological events and human-populated areas. But does having a sense of control lead to better health?

What do we know about how people cope with seemingly random events?

Some people feel as if they are the victims of random events, while others believe themselves to be the beneficiaries of the whims of life. However, the idea that randomness dictates worldly events can create anxiety in people. Even if a person believes randomness is the rule, they can become highly motivated to find meaning in the world and, through this search, a sense that the course of events is determined by the will of individuals or God (Kay et al., 2009; Rutjens & Kay, 2017). In this way, many people cope with stressful life events through **compensatory control**—*psychological strategies people use to preserve a sense of non-random order when personal control is compromised* (Kay et al., 2009). For example, people who are skeptical of any divine purpose in the world may change their view in the wake of personal or societal tragedy. These

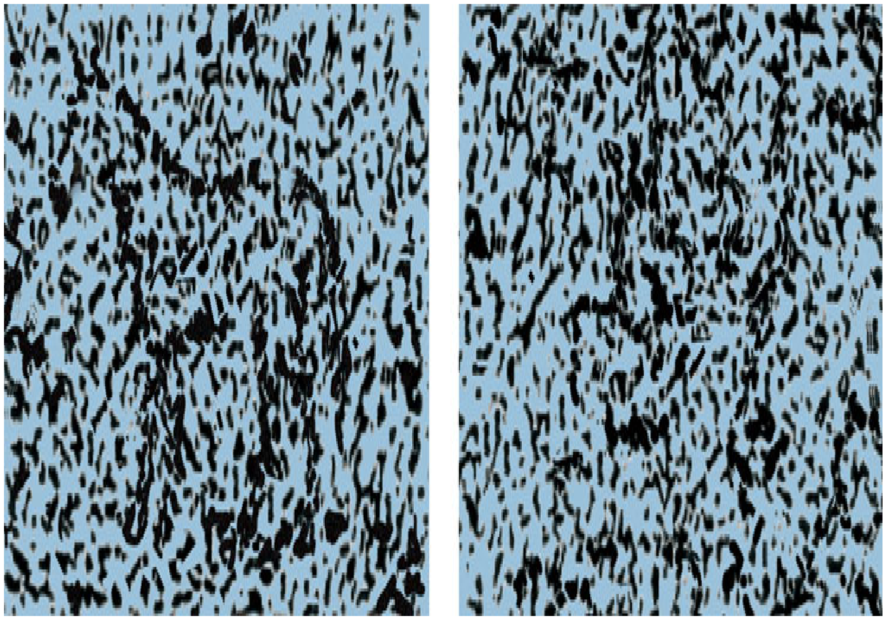
observations are primarily correlational, but researchers have conducted experiments to determine causal relationships between sense of control and beliefs about randomness versus orderliness.

How can science explain compensatory control?

To study compensatory control, researchers have developed a laboratory task that manipulates people's sense of personal control over a situation (Whitson & Galinsky, 2008). In one study, participants completed a concept identification task in which two symbols were presented on a computer screen and the participant had to guess which symbol correctly represented the concept that the computer had chosen (e.g., the colour of the symbol, its shape). The computer provided feedback on whether the participants chose the correct or incorrect symbol after each trial. Half of the participants received accurate feedback, while the other half received completely random feedback—sometimes their correct answers were recorded as incorrect, and vice versa. Participants receiving random feedback reported feeling a lower sense of control on a self-report measure.

Following the concept identification task, the participants then viewed multiple pictures, such as those shown in Figure 14.10. If you look closely, you will see that one of the pictures has a horse-like figure in it, whereas the other image has no discernible pattern. Participants in both conditions reported seeing faintly drawn figures, such as the horse. However, participants who had a diminished sense of control induced by the random feedback they received on the computer task were more likely to report seeing patterns within completely random images (Whitson & Galinsky, 2008).

Figure 14.10 Seeing Images Where There Are None

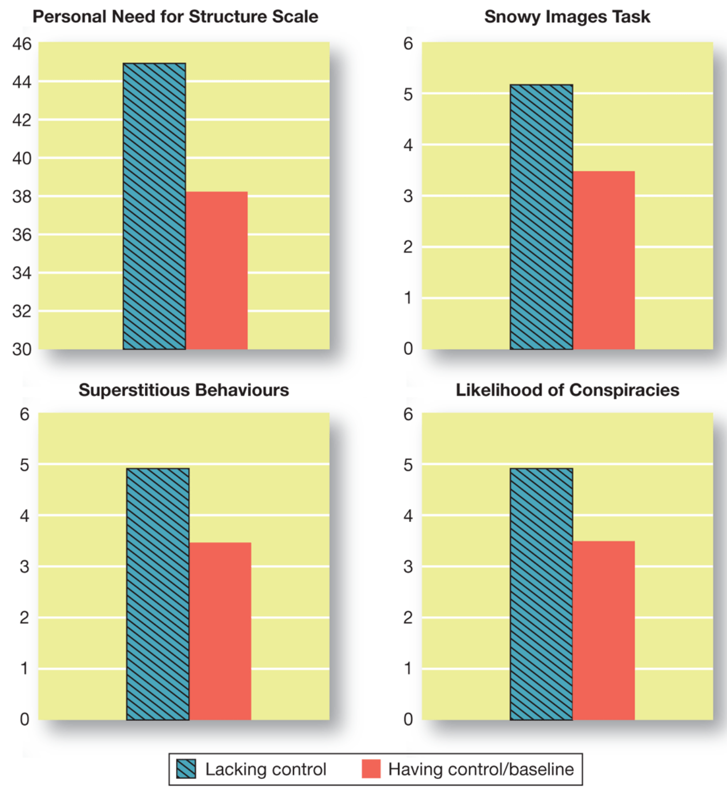


Do you see a figure in the image on the left? You may see a figure resembling a horse. What about on the right? There is no discernible image intended for this image. Psychologists have found that individuals who feel as though they lack control are more likely to detect patterns in the image at right than are people who feel a greater sense of control (Whitson & Galinsky, 2008).

Source: From Whitson, J. A., & Galinsky, A. D. (2008). Lacking control increases illusory pattern perception. *Science*, *322*, 115–117. Copyright © 2008 by AAAS. Reprinted through Rightslink, by permission of the AAAS.

It appears that when people feel their sense of control is undermined, they compensate by heightening their search for structure in the world, to the point of calling upon their imagination. This is evident in other domains as well, not just detecting patterns in random, snowy images. People also gain a greater need for structure and become increasingly willing to believe in superstitious rituals and conspiracy theories when their sense of control is diminished (Figure 14.11; Landau et al., 2015; Whitson & Galinsky, 2008).

Figure 14.11 Exercising Compensatory Control



When people feel as though they lack control over the world, their need for structure, perceptual order, and beliefs in superstition and conspiracies increases. Participants who perceived that they were in control of events were *unlikely* to see images in snowy pictures (see Figure 14.10) and did *not* hold superstitious beliefs or endorse conspiracy theories. When people perceived that they had lost a sense of control during the experimental procedure, they reported a greater need for structure, perceived images in random arrays, became more superstitious, and endorsed conspiracy theories (Whitson & Galinsky, 2008).

Source: Based on data from Whitson, J. A., & Galinsky, A. D. (2008). Lacking control increases illusory pattern perception. *Science*, *322*, 115–117.

Can we critically evaluate this evidence?

A major advantage of the study described here is that the researchers were able to experimentally induce a perceived lack of control in the participants who received random feedback on

their performance on the computerized task. The observation that these participants then perceived images within randomness and showed a heightened belief in superstition and conspiracies may help to explain how people respond to lost control outside of the laboratory. Of course, one limitation is that a real-world lack of control, such as that which occurs in the face of a natural disaster or the loss of a job, has far greater consequences. Thus, as with any laboratory experiment, there is a limit to the degree to which the results generalize.

Why is this relevant?

Having a sense of control greatly affects how we think about and interpret the world. In addition, it affects our health. Individuals who believe they can predict and influence present and future events tend to have improved physical and mental well-being compared to people who believe the opposite. For example, patients who are scheduled to undergo medical procedures, such as a colonoscopy, have reduced anxiety for the procedure if they are given clear, informative tutorials about the procedure before it occurs (Luck et al., 1999).

Researchers have found that when people perceive that they have lost a sense of control during an experimental procedure, they report a greater need for structure, perceive images in random arrays, become more superstitious, and endorse conspiracy theories (Kay et al., 2009). These researchers have also suggested that religion is sometimes used as a form of compensatory control (Kay et al., 2010).

People may also compensate for their lack of control by performing superstitious rituals, which can provide a sense of at least partial control over outcomes. This can be seen in everyday examples, such as among athletes who follow the same steps

when preparing for a game, as well as in extreme, maladaptive forms, such as in obsessive–compulsive disorder (covered in Module 15.3).

Module 14.3 Summary

Listen to the Audio

14.3a Know . . . the key terminology associated with coping and well-being.

Review Module 14.3

Start Over Swap

0/13 REVIEWED · 0 MASTERED

post-traumatic growth

Previous Next Got It!

14.3b Understand . . . how control over the environment influences coping and outlook.

Psychologists have discovered that people (and dogs) become more willing to allow unpleasant events to occur if they learn (or believe) that

their behaviour brings no change. Having at least some degree of control helps people (and dogs) cope with these events. When control is threatened, people use compensatory responses, such as detecting order within random images.

14.3c Understand . . . positive and negative styles of coping.

Whether someone copes using a positive or negative style is related to personality (e.g., optimism vs. pessimism). Positive coping includes the concept of resilience—the ability to recover from adversity, and even benefit from the experience, as is the case with post-traumatic growth. Coping via negative affectivity and pessimism can have both psychological and physiological disadvantages.

14.3d Apply . . . your knowledge of the beneficial effects of optimism to help you reframe stressful situations as positive opportunities.

Apply Activity

For each of the following four situations, try to think of both a pessimistic and an optimistic way of interpreting the event.

1. You find out that you are one of four people to be scheduled for an interview for a job you really want.
2. Your flight home from Europe is overbooked, so your return home is delayed by a day.
3. Your car has a flat tire and you have to bike 10 km to get to school in time for your 10 AM class.
4. Your friend decides to stop attending the kickboxing class that you really enjoy.

How did you feel after each optimistic and pessimistic interpretation? Did you feel better after putting a positive spin on things?

14.3e Analyze . . . whether activities such as relaxation techniques and meditation actually help people cope with stress and problems.

Meditation and other relaxation methods have been found to be quite effective in reducing stress. While some training and practice may be necessary, these techniques are by no means inaccessible to those who are motivated to pursue them.

Chapter 15
Psychological Disorders

Listen to the Audio

15.1 Defining and Classifying Psychological Disorders

- Classifying Psychological Disorders
- Challenges with Classifying Psychological Disorders
- Working the Scientific Literacy Model: Culture and Diagnosing Mental Disorders
- Applications of Psychological Diagnoses
- Module 15.1 Summary

15.2 Personality and Dissociative Disorders

- Cluster A Personality Disorders: Odd and Eccentric Behaviours
- Cluster B Personality Disorders: Dramatic and Erratic Behaviours
- Working the Scientific Literacy Model: The Criminal Psychopath
- Cluster C Personality Disorders: Anxious and Fearful Behaviours
- Dissociative Identity Disorder
- Module 15.2 Summary

15.3 Anxiety, Obsessive-Compulsive, and Depressive Disorders

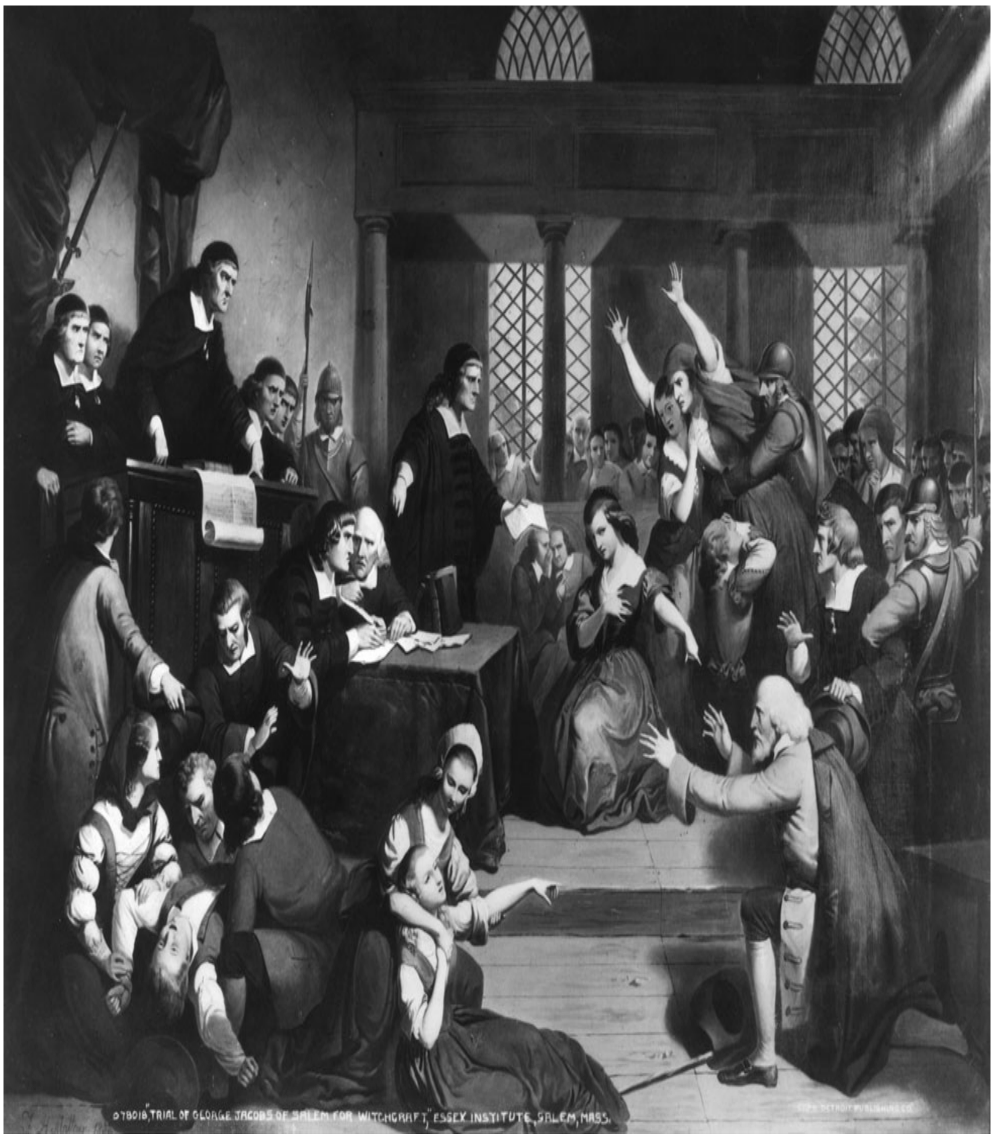
- Anxiety Disorders
- Working the Scientific Literacy Model: Specific Phobias
- Obsessive-Compulsive Disorder
- Mood Disorders
- Module 15.3 Summary

15.4 Schizophrenia

- Symptoms and Types of Schizophrenia
- Explaining Schizophrenia
- Working the Scientific Literacy Model: The Neurodevelopmental Hypothesis
- Module 15.4 Summary

Module 15.1 Defining and Classifying Psychological Disorders

Listen to the Audio



MPI/Archive Photos/Getty Images

Learning Objectives

15.1a Know . . . the key terminology associated with defining and classifying psychological disorders.

15.1b Understand . . . advantages and criticisms associated with the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5).

15.1c Apply . . . your knowledge of the mental disorders defence to decide if defendants are criminally responsible for their actions.

15.1d Analyze . . . whether the benefits of labelling psychological disorders outweigh the disadvantages.

Over the centuries, our understanding of psychological disorders has come a very long way. In the Middle Ages, people who we would now consider mentally ill may have experienced a wide range of reactions from society. They may have been viewed as possessed by the Devil, and requiring religious exorcism or even torture. The reason for these extreme responses was that many people in that era believed that individuals who exhibited unusual behaviours such as responding to voices that no one else heard or having hallucinations were under the sway of evil spirits inhabiting their bodies (Hunter & Macalpine, 1963).

By the 16th century, this belief was part of the witch scares, which for at least two centuries created mass paranoia as the public sought protection from witches, who were believed to gain their power through an allegiance with the Devil. Armed with the Malleus Maleficarum (Hammer of the Witches), *a 1486 German text filled with detailed instructions for identifying witches, countless people were subjected to "tests," such as looking for the "Devil's mark" on the body, a visible spot such as a mole or birthmark that could be interpreted as a sign of*

allegiance with the Devil. Those who were identified as witches received treatments such as drowning or being burned at the stake (which tended not to work well).

Although these historical events seem ridiculous in the 21st century, the people of that time faced a problem that we still haven't completely solved: How do you identify and help someone with a psychological disorder? Thankfully, our ability to do both has advanced considerably in the past few hundred years.

Abnormal psychology *is the psychological study of mental illness*. How do psychologists determine whether a person's behaviours are abnormal? The key criterion used by psychologists in deciding whether a person has a disorder is whether the person's thoughts, feelings, or behaviours are **maladaptive**, meaning that they *cause distress to oneself or others, impair day-to-day functioning, or increase the risk of injury or harm to oneself or others* (American Psychiatric Association, 2013). However, as you will read in Modules 15.2–15.4, there are a number of forms of maladaptive behaviour. Importantly, not all forms of maladaptive behaviours (i.e., psychological disorders) respond to the same types of treatments. Therefore, it is critical for psychologists and psychiatrists to find ways to accurately diagnose the different types of psychological disorders. Doing so will make it more likely that patients will receive treatments that are appropriate for their illness. In this module, we discuss the challenges associated with classifying these different types of psychological disorders.

Classifying Psychological Disorders

Listen to the Audio

Although the examples at the beginning of this module dramatically portray how mental illnesses were dealt with in certain points in European and North American history, it is important to point out that these instances were the exception rather than the rule. Instead, most people with psychological disorders were taken care of by their family. Only in extreme cases were individuals placed in the limited number of **asylums**, *residential facilities for the mentally ill*. Between 1403, when the Priory of St. Mary of Bethlehem housed six "insane" men, to the 1750s, when primitive psychiatric wards existed in several European countries, asylums were essentially storage facilities for patients. This changed in 1751, when the director of St. Luke's Hospital in London (U.K.), William Battie, began to write about the potential therapeutic benefits of being treated by asylum physicians and staff. Battie's work, along with important contributions from Philippe Pinel, a physician in France (see Module 16.1), led to the birth of modern psychiatry. A central problem in this modern psychiatry, however, was identifying which patients would—and would not—benefit from treatment. A classification system with clear criteria was needed.

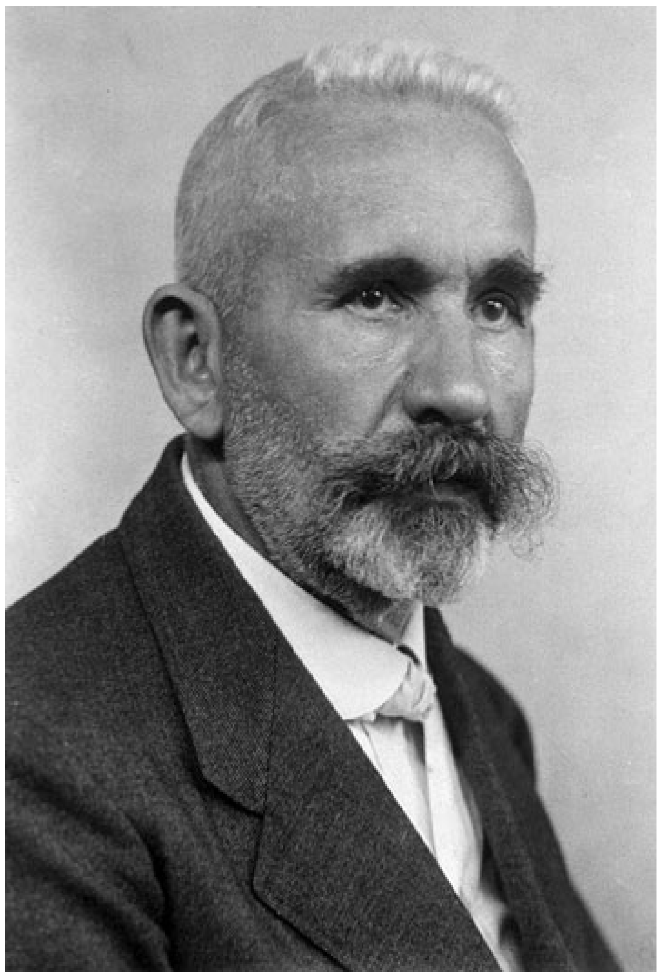
Early Classification Systems

Listen to the Audio

At the beginning of the 1800s, most mental illnesses were classified as being *mania* (which included symptoms such as hallucinations and excessive energy) and *melancholia* (which included depression and anxiety). Melancholia was often curable, whereas mania had a much poorer prognosis. The physicians treating these cases in asylums also had to treat patients suffering from what we would now call neurological disorders, including dementia caused by alcoholism and syphilis, a venereal disease that was quite common during the 1800s (Shorter, 1997). Given that physicians often treated both psychiatric and neurological cases, it is not surprising that most mental illnesses were diagnosed in the same way as physical illnesses. Psychiatry at this time adopted the **medical model**, *which sees psychological conditions through the same lens as Western medicine tends to see physical conditions—as sets of symptoms, causes, and outcomes, with treatments aimed at changing physiological processes in order to alleviate symptoms*. Through this lens, psychological disorders such as depression, anxiety disorders, or autism can be approached in the same manner as conventional medicine would approach diabetes or cancer.

It is at this point in the late 1800s that we meet one of the most important psychiatrists in the history of medicine: Emil Kraepelin. Kraepelin was a German psychiatrist who spent time studying behaviour with Wilhelm Wundt, director of the world's first psychology laboratory in Leipzig. Later, while working in an asylum, Kraepelin created data cards for each

of the patients under his care in order to track how the patients' mental illnesses progressed over time. He would sometimes diagnose the patients at different points in their treatment in the asylum to see how their symptoms changed. By testing large numbers of individuals, he was able to see which symptoms seemed to occur together (e.g., depression and anxiety). He was also able to tell which disorders were curable and which ones were more likely to get worse over time.



Emil Kraepelin was one of the most influential clinicians in the history of psychiatry and psychology. His attempts to classify psychological disorders based on their long-term outcomes influenced how future clinicians diagnosed mental illnesses.

Ullstein bild Dtl/Getty Images

Kraepelin published his clinical observations in a widely read textbook that he frequently updated. In the sixth edition of this book, he stated that psychological disorders could be divided into 13 large groups. Among these 13 groups were two related to *psychosis*, when an individual has difficulties distinguishing between what is real and what is imagined. Emotional psychoses would include the large mood swings associated with what he called manic-depressive disorder (what we now called bipolar disorder; see Module 15.3). Non-emotional psychoses involved disorganized thoughts such as those related to schizophrenia (see Module 15.4). Thus, through careful observation, Kraepelin was able to distinguish between two prominent disorders that are still treated by healthcare workers today.

The importance of observations such as Kraepelin's, along with the emergence of experimental psychology research in the early 20th century, pushed the treatment of mental illness into a more prominent position in medicine. This attention, however, highlighted the need for people researching or treating mental disorders to have a common set of terminology. This would ensure that psychologists and psychiatrists working in hospitals in Toronto and Los Angeles would be referring to the same thing when they wrote about an illness such as depression. To address this concern, the American Psychiatric Association published a *Statistical Manual for the Use of Institutions for the Insane*. This short publication provided basic descriptions of common psychological disorders. Although the book was revised a number of times, it had one major problem: only about 10% of clinical cases in hospitals matched its descriptions (Greenberg, 2013)!

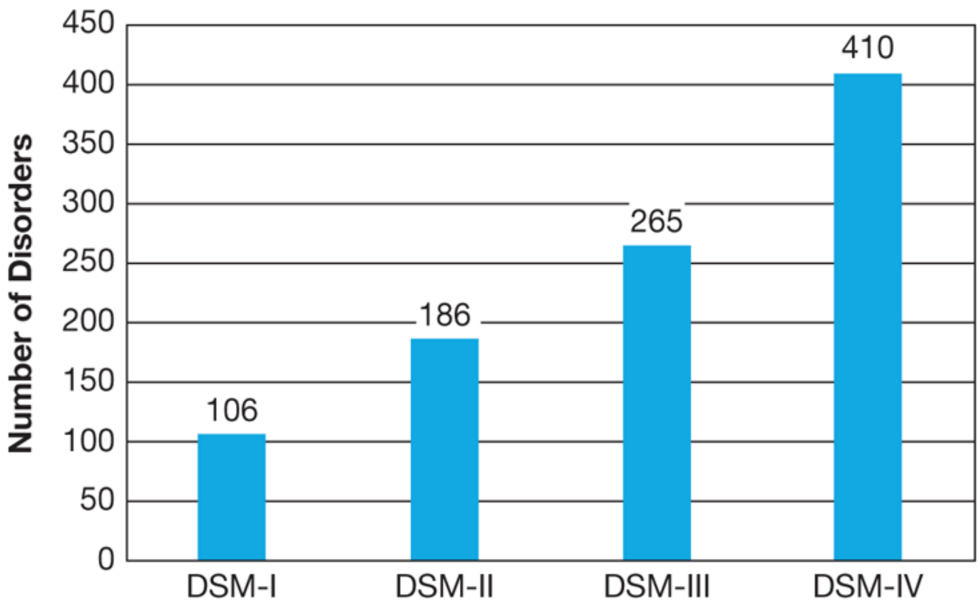
The pressure was on the American Psychiatric Association to create a reference book that would allow researchers and clinicians to accurately diagnose different mental illnesses. In 1952, it delivered a game-changer.

The Diagnostic and Statistical Manual (DSM)

Listen to the Audio

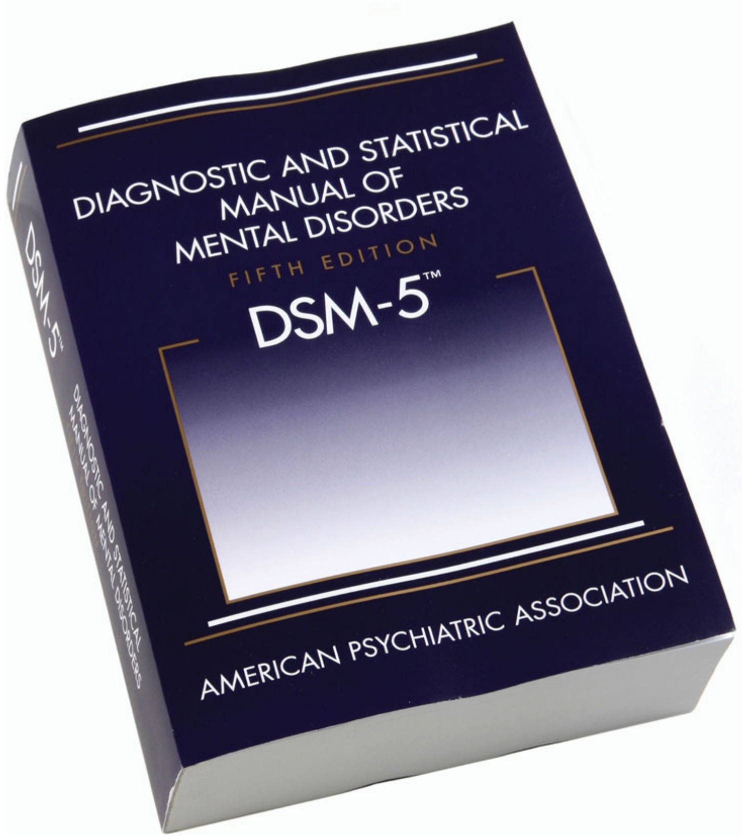
In World War II, American psychiatrists were hired in large numbers by the U.S. military to aid in the selection of soldiers and to treat mental disturbances resulting from military duty. This led to the creation of a classification scheme that allowed the psychiatrists to identify the different mental disturbances experienced by soldiers (Houts, 2000). Building on the military's diagnostic system, as well as the sixth edition of the World Health Organization's *International Statistical Classification of Disease* (which included mental disorders), the American Psychiatric Association created the **Diagnostic and Statistical Manual of Mental Disorders (DSM**), *a standardized manual to aid in the diagnosis of disorders*. The first edition of the DSM (DSM-I) described the symptoms of 106 different mental disorders. However, some of these disorders reflected the cultural biases of that era. For instance, homosexuality was listed as a psychological disorder (and remained one until 1980). The DSM-I represented an initial attempt to organize psychiatric and psychological data into a recipe book of sorts for clinicians. But, like most first attempts, it was an imperfect document. It has been revised several times since its original publication. With each revision, the number of psychological disorders has increased, sometimes dramatically (see Figure 15.1).

Figure 15.1 The Number of Disorders in the DSM over Time



The number of behaviours that are classified as psychological disorders has changed over the past 80 years. The numbers increased substantially from the DSM-I through the DSM-4.

The current version of the DSM is the DSM-5, released in May 2013. The DSM-5 divides mental illnesses up into 19 categories, each containing several subtypes. For example, one section of the DSM-5 discusses different aspects of depression, another covers anxiety disorders, and another covers schizophrenia. Although each subtype of each disorder is associated with a number of symptoms, there is a subtle difference in how psychological disorders are discussed in the DSM-5. More attention is now paid to how the severity of disorders can exist along a dimension from relatively mild to very debilitating. This scale reflects the variety of patients that therapists see in the clinic. It also makes intuitive sense. You likely know someone who experiences depression but can still usually get to school; other people with depression might not be able to get themselves out of bed. The DSM-5 *attempts* to deal with this variability in the severity of disorders, at least for some conditions.



The American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (DSM) is the most commonly used reference for therapists attempting to diagnose a patient's mental illness. However, although this tool has many positive points, it has also received considerable criticism from researchers and clinicians.

Treating some disorders in a dimensional fashion (i.e., mild to severe) has had some interesting consequences for patients. For example, many of you have heard of Asperger's syndrome, a psychological disorder in which individuals have difficulties in social situations and with understanding other people's emotions. (The character Sheldon from the TV show *The Big Bang Theory* is often used as an example of this disorder). Asperger's syndrome is sometimes treated as a less severe form of *autism*, a developmental disorder associated with poor social skills and that may be accompanied by intellectual impairments. In the DSM-5, Asperger's has disappeared. Individuals who were once diagnosed with this disorder

are either considered mildly autistic or no longer have an illness. Such is the power of a diagnostic manual.

It should be pointed out that the DSM-5 is not intended to be the final version of this diagnostic tool. Its designers assumed that revisions would be published as brain imaging and genetic research shed additional light on mental illnesses. That said, the DSM-5—and psychological diagnosis in general—has received a great deal of criticism in the past few years. The impact of these criticisms on patients, as well as the general public, will be discussed in the next section of this module.

Challenges with Classifying Psychological Disorders

Listen to the Audio

Although the accuracy and reliability of psychologic diagnoses have come a long way in the past 80 years, there are still a number of problems associated with determining whether someone does or does not have a mental illness. Some of these problems are directly related to the DSM-5, whereas others are more philosophical in nature.

What Is "Maladaptive" Behaviour?

Listen to the Audio

One of the thorniest problems in the mental health field has always been how to reliably identify who has a mental disorder in the first place (if a disorder is even a *thing* that you can *have*). Given the immense range of apparently normal human behaviour and experience, how can we determine what is abnormal? As discussed earlier in this module, a key determinant in identifying if someone has a mental disorder is whether their behaviours are *maladaptive*—in other words, do their behaviours harm themselves or others in some way?

On the surface, it seems like this question would be easy to answer. However, there are many exceptions to this guideline. Some behaviours fulfill these criteria but do not necessarily indicate mental illness. Consider the following:

- Heavy drug users and people with psychopathic tendencies may not *think* they have a problem and are therefore not distressed by their behaviours.
- Family members may be concerned about a person's involvement in a new relationship, or may disapprove of body modifications such as tattoos or piercings.
- Mourning the loss of a loved one or having a religious conversion may interfere with a person's day-to-day activities.
- Activists may get arrested for protesting government actions and extreme sports enthusiasts may risk death or injury out of passion for

their sport.

Obviously, the criteria for determining whether a given behaviour should be viewed as a disorder are not perfect and cannot account for all circumstances. But, generally speaking, when a person's behaviour and experience start to become significantly dysfunctional, there may be cause for concern. In order to make more specific diagnoses and determine exactly what type of disorder a person may have, mental health professionals rely on the DSM-5's carefully designed system. Unfortunately, this system is not perfect.

Deciding whether someone's behaviour is maladaptive is not always as simple as it seems on paper. People who take part in extreme sports risk their lives in order to experience a thrill.

Sky Antonio/Shutterstock

Critiquing the DSM

Listen to the Audio

Psychologists and psychiatrists don't have precise tools, like litmus tests in chemistry that can tell you precisely whether something is an acid or a base. Instead, the diagnostic process is subjective, involving human clinicians trying to make sense of the different behaviours being displayed by their clients. In order to try to help clinicians, the DSM offers lists of specific symptoms that are indicative of specific disorders. These lists are an attempt to make the diagnostic process more objective, which should decrease the likelihood that diagnoses are based on individual clinicians' biases.

Unfortunately, this doesn't entirely solve the problem for many reasons. For one, a clinician still has to subjectively decide whether a client displays each symptom and whether it is severe enough to be considered a *symptom* or just *normal experience*. For example, at what precise point does "depressed mood" pass out of the range of normal experiences (we're all sad sometimes and go through difficult periods in life) and into the pathological range? Another problem is that different disorders often share many common symptoms. As a result, different mental health professionals might make different diagnoses. The DSM was created, in large part, to help make the process of diagnosing a disorder more objective and reliable, but the very nature of human experience is often subjective, vague, and unreliable.

An additional weakness of the DSM is that there is a fine, and essentially arbitrary, line between whether a person is considered to have a disorder or not. For each disorder, the DSM provides a list of possible symptoms and guidelines as to how many of the symptoms the person must have before being given the diagnosis. If a person seems to have the necessary number (e.g., five out of nine possible symptoms), then they have the disorder, but with one symptom less, they don't. In practice, what this means is that the diagnosis a person receives, and even whether a person receives any diagnosis at all, can depend on a single symptom. Not surprisingly, this reduces the reliability of diagnoses.

The Power of a Diagnosis

Listen to the Audio

What are the outcomes of diagnosing a person as having a particular disorder? On the positive side, it is hoped that receiving a diagnosis should make people more likely to seek and receive effective treatment. Also, a diagnosis should facilitate communication among mental health professionals. A label indicates a set of symptoms, probable causes, and potential treatments, thus summarizing and highlighting the important pieces of information that will be useful for treating the person. However, these diagnostic labels can also have their drawbacks.

One concern related to psychological diagnoses is that once a person has been labelled as having a disorder, the label itself may change how that person is viewed by others, and how subsequent behaviours are interpreted. A related problem is that seeing oneself as mentally ill can be associated with low self-esteem or feelings of helplessness. In some cases, a diagnosis may lead a person to indulge in even more extreme or destructive behaviour patterns. Because of stigma and negative attitudes toward the mentally ill, people may expect that other people will reject and devalue them. This perception may lead them to withdraw from social contact and fail to seek the support that could help them (Kroska & Harkness, 2006; Link, 1987).

People may also become demoralized about their capabilities and themselves in general, which then interferes with their motivations and goal-related striving. Sadly, in a classic self-fulfilling prophecy, the long-

term effects can be that people end up experiencing the social rejection and stigmatization they initially feared (Kroska & Harkness, 2006). In short, diagnostic labels are supposed to help, but they have the potential to cause harm. This doesn't necessarily mean we should stop using diagnostic labels. But it does mean that we should be especially concerned about using them accurately.

The challenge of accurately classifying mental illness becomes particularly apparent when we examine the role of culture in diagnosing psychological disorders.

Review Attitudes toward Mental Illness

This scale measures stigma towards individuals who have a severe mental illness. Complete the scale to compare your score to a large sample of traditional age (18-23 year old) college students.

1. If I had a mentally ill relative, I wouldn't want anyone to know.

- ◯ Strongly Agree
- ◯ Moderately Agree
- ◯ Neither Agree nor Disagree
- ◯ Moderately Disagree
- ◯ Strongly Disagree

2. Most of my friends would see me as being weak if they thought that I had a mental illness.

- ◯ Strongly Agree
- ◯ Moderately Agree
- ◯ Neither Agree nor Disagree
- ◯ Moderately Disagree
- ◯ Strongly Disagree

Previous Next

Source: Watson, A. C., Miller, F. E., & Lyons, J. S. (2005). Adolescent Attitudes Toward Serious Mental Illness. *Journal of Nervous and Mental Disease*, 193, 769–772.

Working the Scientific Literacy Model

Culture and Diagnosing Mental Disorders

Listen to the Audio

Although much is made of the advances in our knowledge of the biological causes of psychological disorders, there is also increasing awareness of the role that culture plays in the development and symptoms of many mental illnesses. However, this was not always the case. For most of psychology's history, the role of culture in mental illness was either pushed to the periphery or viewed through a Western cultural lens.

What do we know about culture and diagnosing mental disorders?

Throughout much of psychology's history, the discussion of culture and mental illness often turned to **culture-bound syndromes**, *expressions of distress that are recognized across a given culture but that tend not to appear outside of that culture*. One such syndrome is known as *ataque de nervios*. This disorder, which can occur in Latin American cultures, involves trembling, uncontrollable crying and/or shouting, fainting episodes, and, in some cases, aggressive behaviour. Another example is *neurasthenia* or *shenjing shuairuo*, a relatively common Mandarin Chinese ailment in which a person experiences extreme fatigue, physical weakness, pain, and problems with relaxation after periods of mental effort. However, although illnesses such as *ataque de nervios* and *neurasthenia* were both included in the

DSM-IV, they were often viewed as interesting windows into a foreign culture rather than useful information that could affect how North Americans of Latino or Chinese heritage could be treated. In other words, culture was often viewed as something that influenced disorders that occurred "over there" rather than disorders that occur "here."

How can science explain the effect of culture on diagnosing mental disorders?

A number of studies have found that the rates of common disorders like anxiety, depression, and schizophrenia differ across cultures (Kirmayer & Ryder, 2016). For example, the rates of anxiety disorders (discussed in Module 15.3) can vary by up to three times depending upon where one lives. These rates are higher in Latin America and lower in East Asian countries, with Canada and the United States falling in between (Baxter et al., 2014). Rates of schizophrenia are higher in African and Afro-Caribbean immigrants than in other immigrant groups (Veling et al., 2006). We also know that when people immigrate to a new country like Canada or the United States, the rates of psychological disorders are lower if they move into neighbourhoods that have larger number of people from their country of origin (Jurcik et al., 2013). Given that the human genome does not differ much across the globe, it is safe to conclude that these differences are due to culture, or to an interaction between culture and biological variables.

There are also cultural differences in the willingness to seek help for disorders, which can influence how open a patient will be with a clinician and thus the accuracy of the resulting diagnosis. Some researchers have found that people from ethnic minorities prefer to seek help from a clinician from their own ethnic group (USDHHS, 2001). Other research has found that some groups

prefer to speak to their primary care physician rather than a mental health specialist, as there is less stigma associated with talking to a person's doctor (Hwang et al., 2006, 2008).

Can we critically evaluate this information?

An obvious question that arises from these cross-cultural studies is "If cultural information is important, can it actually be used to improve the accuracy of diagnoses?" In order to test this possibility, the DSM-5 now includes the Cultural Formulation Interview, a supplement aimed at helping clinicians collect additional information about cultural factors that could influence diagnoses (Lewis-Fernández et al., 2015). The rationale for this interview was that increasing awareness of a patient's cultural context, including the stresses of immigration (if applicable), would lead to more efficient and effective treatments for people seeking help. Although only a few years have passed since its development, the initial results of studies using the Cultural Formulation Interview appear positive. Research has shown that this interview can improve the accuracy of diagnoses such as schizophrenia and can improve overall clinical outcomes of non-Caucasian patients (Kirmayer et al., 2014).

An additional question that could emerge from this research is *how* can culture influence the rates of different disorders? What is the mechanism involved? This is a valid question. The most likely explanation involves epigenetics and the expression of different genes (see Module 3.1). Different geographical locations will have different climates, pollution levels, violence, poverty, and stress levels. All of these factors can influence whether or not a gene is expressed (Meloni, 2014). This, in turn, could account for cultural differences in both the characteristics and severity of different psychological disorders. However, much more research

is needed on this topic before it can influence the diagnosis of psychological disorders.

Why is this relevant?

Understanding how culture influences the development and appearance of various psychological disorders will improve the accuracy of diagnoses. The inclusion of a Cultural Formulation Interview into some diagnoses is a very positive step forward, particularly given the dramatic increases in immigration and migration that the world is currently experiencing. If psychologists and psychiatrists can continue to improve their cultural awareness, it will allow them to overcome one of the major challenges of diagnosing psychological disorders.

Immigrating to a new country and culture can be very difficult. Researchers have found that many immigrants prefer to seek treatment from someone who has a similar ethnic background.

SeventyFour Images/Alamy Stock Photo

Applications of Psychological Diagnoses

Listen to the Audio

Perhaps one of the most important things to appreciate about psychological disorders is that there is no perfect test for identifying them. Being able to reliably diagnose particular disorders is a central and ongoing challenge to the mental health fields, and has an impact on problems that range from getting individuals the treatment they need to assessing criminal responsibility in the legal system. The fact that our measurements of psychological disorders are not nearly as accurate as we would like makes these issues even more difficult to deal with. In this section, we will discuss two settings in which these types of decisions can have a profound impact on individuals.

Psychological Diagnoses in the Classroom: ADHD

Listen to the Audio

Classroom behaviour is one area that presents diagnostic challenges for psychologists and the educators they are helping. Given that the frontal lobes of the brain, which serve to inhibit many behaviours, don't fully develop until the early 20s, it is easy to see why children sometimes "act out." All children misbehave some of the time. But some children's activity in the classroom is outside of the normal range of behaviour.

Many children are now diagnosed with **attention-deficit hyperactivity disorder (ADHD)**, *a developmental disorder in which children show inappropriate levels of hyperactivity and impulsivity while also having problems maintaining their attention to people or activities*. These children tend to be fidgety in class, talk quickly and excessively, and fail to listen to teachers or peers when spoken to (Tarver et al., 2014). These children can cause disruptions that not only reduce their own learning, but can alter the learning environment for the other students as well. The challenge for educators and psychologists is to identify these children so that they can receive some form of treatment.

The DSM-5 states that an individual must have a minimum of six symptoms of inattention (i.e., failing to pay attention) or six symptoms of hyperactivity/impulsivity in order for someone to receive a diagnosis of ADHD (American Psychiatric Association, 2013). The goal is to select the children (or occasionally adults) who have enough symptoms that they

have become problematic for the individual while also avoiding diagnosing people who only display a few disruptive behaviours. If the psychologists are successful, it can mean that students will gain access to behavioural therapies shown to help with impulsivity and inattention and that can improve the students' educational outcomes (Molitor & Langberg, 2017). An ADHD diagnosis might also lead to pharmaceutical treatments that can target the frontal lobe and its connections with dopamine-releasing brain areas in the basal ganglia (Nakao et al., 2011).

However, some critics have noted that since ADHD was added to the DSM-III in 1980, diagnoses have skyrocketed, although primarily in North America (in Europe, ADHD only seems to occur 10% as often). Estimates of the prevalence of ADHD range from the most common rate of 3% to 5% up to 16% (Rowland et al., 2015). Critics also charge that many children are being medicated for disruptive activity that is still within the normal range of childhood behaviour.

There is no definitive answer to this issue. On the one hand, an accurate diagnosis can allow a hyperactive child to receive a relatively normal education. On the other hand, some children may be misdiagnosed (i.e., a false alarm) and could end up being unnecessarily medicated. ADHD shows us the challenges and responsibilities associated with psychological diagnoses.

ADHD is a common psychological diagnosis for children who have excessive energy and difficulties paying attention in school. Early diagnosis allows teachers and psychologists to create programs that can have a profound impact on the students′ educational outcomes. However, the large number of children that are now being diagnosed has led some critics to question the reliability of this diagnosis.

martinedoucet/E+/Getty Images

Psychological Diagnoses in the Courtroom: The Mental Disorder Defence

Listen to the Audio

The challenges associated with psychological diagnoses can play a large role in the criminal justice system as well. You have no doubt heard that in some trials a defendant will plead "not guilty by reason of insanity." The legal reasoning behind a person being defined as legally sane (i.e., criminally responsible) or not is based on the *M'Naghten rule*, which goes all the way back to 1843 in Great Britain. Daniel M'Naghten assassinated the Prime Minister's secretary, but the jury was convinced that he was not guilty. They believed that he had been incapable of knowing that what he did was wrong, so M'Naghten was committed to a mental institution, and the plea "not guilty by reason of insanity" entered the legal profession.

In Canada, the insanity defence is now referred to as the **mental disorder defence**. This defence does not deny that the person committed the offence, but *claims that the defendant was in such an extreme, abnormal state of mind when committing the crime that they could not discern that the actions were legally or morally wrong*. For example, a person could cause a car accident or commit murder when they are experiencing severe symptoms of a disorder, such as the hallucinations that sometimes occur in people with schizophrenia (see Module 15.4). Applying the mental disorder defence is extremely tricky, and indeed, it is rarely used. One study showed that this defence is used in less than 1% of cases in Canadian courts and it has a success rate of less than 25% (Maxwell, 2015).

Whether or not we can objectively and accurately measure “sanity” is extremely important, as it could be the deciding factor in whether a person becomes a convicted felon or receives psychiatric treatment. However, determining whether or not a person was “sane” when they committed a crime is not an easy thing to do.

Consider two well-known Canadian examples of the mental disorder defence. In 2006, in Barrie, Ontario, Elaine Campione drowned both of her daughters (aged 19 months and three years) in a bathtub. At the time, she was involved in a custody battle with her ex-husband. Elaine had been diagnosed with a variety of psychological disorders and suffered delusions, including that others were trying to steal her children. Her lawyer argued that she was not criminally responsible for her actions, but the Crown countered that even though she was mentally ill, her particular disorders did not prevent her from knowing right from wrong. She was convicted of first-degree murder (Supreme Court of Canada, 2015).

In Edmonton, Alberta, in 2013, Nerlin Sarmiento drowned her seven-year-old son in a bathtub. Her lawyer argued that she was so deeply overwhelmed by a major depressive episode that was part of her bipolar disorder that she had become convinced that she was actually rescuing her son from a life of poverty and suffering, and believed that killing him was an act of mercy and kindness. In this case, the courts decided that Nerlin was not criminally responsible for her son’s death, and required her to receive psychiatric treatment rather than going to jail (CBC News, 2013).

The critical issue, legally speaking, is whether the person was, at the time of committing the crime, capable of knowing that what they were doing was wrong. The Courts decided that Elaine Campione knew what she was doing was wrong, whereas Nerlin Sarmiento did not. Cases such as these show both the importance of psychology to the legal system and the

difficulties associated with understanding a defendant's mental state. They also highlight the importance of accurately diagnosing a patient's condition.

Module 15.1 Summary

Listen to the Audio

15.1a Know . . . the key terminology associated with defining and classifying psychological disorders.

Review Module 15.1

Start Over Swap

0/8 REVIEWED · 0 MASTERED

Diagnostic and Statistical Manual of Mental Disorders (DSM)

Previous Next Got It!

15.1b Understand . . . the advantages and criticisms associated with the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5).

Using the DSM-5 ensures that all psychologists and psychiatrists are using the same criteria to define different psychological disorders; this improves the reliability and consistency of psychological diagnoses. However, the DSM-5 has faced many criticisms. First, psychologists need to decide if a symptom is severe enough to warrant treatment. Second, the number of symptoms that must be present before a disorder is diagnosed seems somewhat arbitrary (e.g., five out of nine possible symptoms). Third, although the large number of possible disorders may make it easier for mental health workers to make a diagnosis, it may also lead to unnecessary diagnoses. Fourth, there is currently a need for more biological or genetic markers to be added to the diagnostic criteria for many disorders.

15.1c Apply . . . your knowledge of the mental disorders defence to decide if defendants are criminally responsible for their actions.

The legal consideration of "sanity" hinges on whether a person who commits a crime understands that their actions are wrong in a legal or a moral sense.

Apply Activity

Based on what you read about criminal responsibility and the mental disorders defence, how would you judge the following two cases: guilty or not guilty? (Note: we have "toned down" elements from real-world cases to make them much less graphic. However, anyone who is sensitive to descriptions of violence should feel free to skip this section.)

- *Case 1:* Tyson was diagnosed with schizophrenia two years ago. Although his symptoms have generally been under control, he has heard voices and seen things that weren't really present (hallucinations) on some occasions. During one of these episodes, he

thought that someone waiting at the bus stop was a demon walking toward him. Tyson attacked the man, sending him to the hospital overnight.

- *Case 2:* Rick received treatment for depression for several years. Although his symptoms were generally under control, he still had some problems controlling his emotions. While working on a group project at work, Rick became involved in an intense argument with his coworkers, whom he felt were not working hard enough. Rick attacked one coworker, sending him to the hospital overnight.

15.1d Analyze . . . whether the benefits of labelling psychological disorders outweigh the disadvantages.

To evaluate the importance of the DSM-5's labels, it would be helpful to consider their functions. They organize large amounts of information about symptoms, causes, and outcomes into terminology that mental health professionals can work with. From a practical point of view, this system meets the requirements of the insurance companies that pay for psychological services. One downside to this process is that once the label is applied, people have a tendency to misinterpret behaviours that are perfectly normal. Another downside is that if insurance and pharmaceutical companies have influence over how the guidelines are decided, then the whole system could be biased in favour of over-diagnosing and over-medicating people.

Module 15.2 Personality and Dissociative Disorders

Listen to the Audio

Moviestore/ Shutterstock

Learning Objectives

15.2a Know . . . the key terminology associated with personality and dissociative disorders.

15.2b Understand . . . how different types of personality disorders can affect interpersonal relationships

15.2c Apply . . . your knowledge of antisocial personality disorder to identify which maladaptive behaviour is consistent with each disorder.

15.2d Analyze . . . the status of dissociative identity disorder as a legitimate diagnosis.

As children, many of us read the story of Charlie and the Chocolate Factory, *a magical children's novel by Roald Dahl. In this story, Charlie, an impoverished boy with a heart of gold, wins a contest that allows him access to Willy Wonka's mysterious chocolate factory. Five children, each with a guardian, are admitted into the factory and receive a tour from Mr. Wonka himself. Over the course of the novel, the four other children—all of whom have unlikeable character flaws—are captured or maimed when they taste experimental foods without permission. Charlie, who virtuously resists these temptations, eventually earns Mr. Wonka's trust and becomes the heir to his factory and fortune.*

It is only upon rereading this novel as an adult that you realize how strange Willy Wonka really is (Rith-Najarian, 2013). For several decades, he distanced himself from human contact and only associated with a strange race of people who were his servants (the Oompa-Loompas). He showed little emotion when four children were disfigured on the same one-day tour of his factory. He made odd movements and expressed himself in a strange manner (e.g., "Oh, my sainted aunt!"). And many of his thoughts are either suspicions about outsiders or are abstract and difficult to interpret (e.g., "Bubbles bubbles everywhere and not a drop to drink!"). Given that these patterns of behaviour appear to be permanent (and continue in the sequel to the book), we can infer that they are not a short-term problem. Willy Wonka has patterns of unusual behaviours and thought processes that have had a negative

effect on his social functioning. Although it is unlikely that this was Roald Dahl's intentions when writing this charming novel, Willy Wonka is a wonderful example of someone with a personality disorder, the topic of this module.

Chapter 12 described the psychological approaches to personality— the relatively stable patterns of thinking, behaving, and relating to others that make each person unique and that are bound up with that person's identity. In certain unusual cases, personality patterns can become deeply entrenched and self-destructive. Mental health professionals define **personality disorders** as *particularly unusual patterns of behaviour (relative to one's cultural context) that are maladaptive, distressing to oneself or others, and resistant to change*. In addition to these points, the DSM-5 is careful to note that the behaviours associated with a personality disorder must have lasted a long time; generally, they can be traced back to adolescence or early childhood. It is also important to ensure that the distressing behaviour patterns aren't due to another psychological disorder (e.g., schizophrenia), to a medical condition (e.g., brain damage), or to a substance such as medications or recreational drugs.

The DSM-5 identifies 10 distinct personality disorders, which are categorized into three clusters based on shared features (see Table 15.1). Cluster A disorders are characterized by odd or eccentric behaviour. Cluster B disorders are indicated by dramatic, emotional, and erratic behaviour. Finally, Cluster C disorders are characterized by anxious, fearful, and inhibited behaviour. In addition to these 10 disorders, the DSM-5 also identifies Personality Disorder Not Otherwise Specified, which is a diagnosis given to individuals who exhibit patterns of behaviour consistent with that of a personality disorder but that does not fit into any of the personality disorder categories described above.

Table 15.1 Types of Personality Disorders

Cluster A: Odd; eccentric

Paranoid Personality Disorder: Sees threats where others do not; difficulty trusting others

Schizoid Personality Disorder: Difficulty forming close relationships with other people; desire to be left alone, if possible

Schizotypal Personality Disorder: Odd or eccentric way of thinking and expressing oneself; difficulty forming close relationships

Cluster B: Dramatic; emotional; erratic

Cluster C: Anxious; fearful; inhibited

Personality Disorder Not Otherwise Specified

Personality dysfunctions may occur that are not accounted for in the above categories. For example, **Personality change due to another medical condition** might be diagnosed if an individual shows persistent personality change after a brain injury. Also, **other specified personality disorder and unspecified personality disorder** might be diagnosed if a person meets some of the criteria for one or more disorders listed above, but sufficient criteria for a specific disorder have not been met.

In this module, we will explore the personality disorders listed in the DSM-5, with particular attention being paid to the Cluster B, the disorders that have received the most attention from researchers (and Hollywood). Before beginning, it is important to note that many readers will have some personality traits in common with various personality disorders. This does not mean you have a mental illness. Each disorder listed in this module requires individuals to have a number of different symptoms; these are best diagnosed by a trained clinician.

Cluster A Personality Disorders: Odd and Eccentric Behaviours

Listen to the Audio

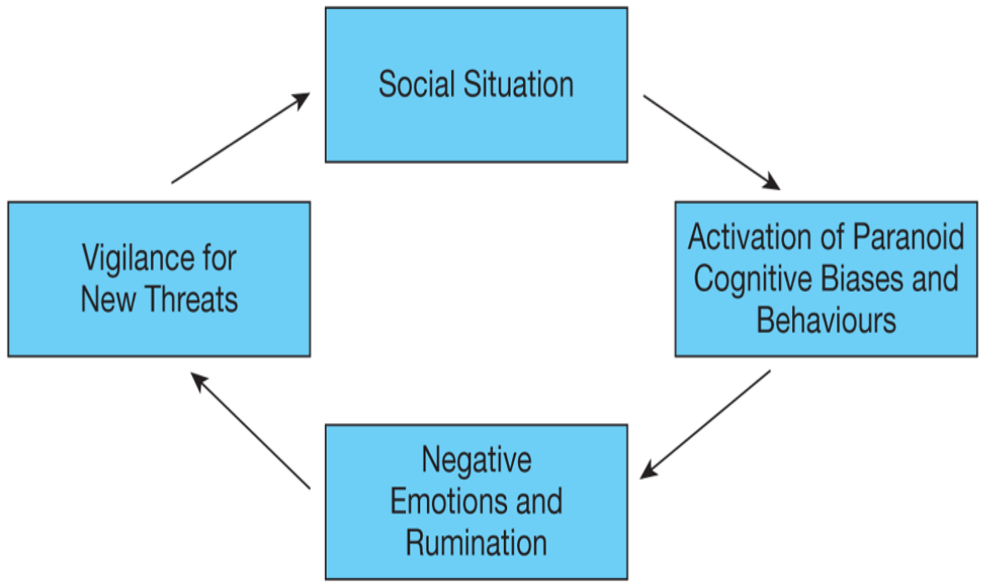
The general theme of Cluster A personality disorders is that the individual tends to perceive and interpret the world in an abnormal—and usually inaccurate—way. They also tend to express their thoughts in a manner that makes it difficult for them to form close social relationships.

Paranoid Personality Disorder

Listen to the Audio

Most people have mistakenly believed that someone else was lying to them or trying to harm them in some way. These mistakes can happen to almost everyone. However, in **paranoid personality disorder (PDP)**, *individuals are consistently preoccupied by the belief that other people are attempting to harm or deceive them; they often react with anger to these imagined social or physical threats*. In other words, people with PDP are suspicious of others even when there is no justification for these suspicions. When asked personal questions by colleagues, they frequently attempt to avoid answering or may simply say that it is “nobody’s business” (Lee, 2017). As a result of these distorted perceptions of other people’s intentions, people with PDP have a difficult time forming close relationships. As depicted in Figure 15.2, this tendency can form a vicious circle of repeated negative social interactions and negative thought processes (Carroll, 2009).

Figure 15.2 Social Cognition in Paranoid Personality Disorder



Individuals with paranoid personality disorder tend to interpret other people's intentions as being malicious. They then tend to repeatedly think about these perceived attacks. As a result, they are primed to interpret future social interactions as being socially (or physically) threatening.

Source: Adapted from Kramer, R. M. (1998). Paranoid cognition in social systems: Thinking and acting in the shadow of doubt. *Personality and Social Psychology Review*, *2*, 251–75.

The DSM-5 indicates that approximately 2% to 4% of the population has some form of PDP, although little is known about the genes involved with this disorder. From a biological standpoint, neuroimaging studies have found that people with PDP show faster neural responses to auditory stimuli than a matched control group (Liu et al., 2007). They also have larger levels of stress hormones in their cerebrospinal fluid, the liquid substance found in the ventricles and sinuses of the brain (Strome et al., 2002). These findings both show that PDP is associated with vigilance for threats, whether they are real or imagined.

Schizoid Personality Disorder

Listen to the Audio

Some personality disorders involve people repeatedly isolating themselves from others. In **schizoid personality disorder (SPD)**, *an individual is socially detached; he or she does not desire close relationships, including being part of a family, and takes little pleasure in most activities*. Individuals with this personality disorder tend to appear cold and aloof. They do not express many emotions and, when they do, these expressions are less intense than is normal. They often appear indifferent to praise or criticism from others. Although this behaviour sometimes comes across as arrogance, this is often not the case. Many people with SPD feel so distant from people that they wonder if other people notice them at all. In a first-person account of his adolescent schizoid personality disorder, British researcher Peter Chadwick recounted a story of being stunned—and oddly pleased—when a car stopped for him at a crosswalk. It reminded him that other people really did notice that he existed (Chadwick, 2014).

Schizotypal Personality Disorder

Listen to the Audio

The final Cluster A personality disorder is **schizotypal personality disorder**, *which consists of both a discomfort with close relationships as well as unusual or eccentric thoughts and behaviours*. Individuals with this personality disorder tend to be suspicious and superstitious. They frequently get lost in their own thoughts and imagine connections between thoughts and events that do not really exist. For example, you might think that your family's dog needs to be walked. But when your sibling actually takes the dog for a walk an hour later, it is unlikely that you would think that this is due to your previous thoughts. Someone with schizotypal personality disorder might make this connection. People with this illness also tend to express their thoughts using abstract and strangely formed sentences, as was the case with our friend Willy Wonka, mentioned in the opening of this module.

There are a number of brain areas that could be involved in a disorder with unusual patterns of thinking and speaking. The region that has been most consistently linked with this personality disorder is the superior temporal gyrus, particularly in the left hemisphere (Rossell et al., 2015). This gyrus is home to the auditory cortex and is also linked with some language processes. It is possible that the strange manner of speaking found in many people with schizotypal personality disorder is associated with the smaller size of this gyrus (Takahashi et al., 2011).

Researchers have identified a number of factors that are associated with the development of schizotypal personality disorder. At the genetic level, one form of the *COMT gene*, which is related to the neurotransmitters dopamine and epinephrine, makes someone more likely to develop SPD (Avramopoulos et al., 2002). Problems during pregnancy—particularly exposure to the flu virus during week 23 of prenatal development—has also been associated with later schizotypal development in males (Machón et al., 2002). Psychological trauma and chronic stress have also been linked with this disorder (Peskin et al., 2011). Again, as in so many illnesses, genetics and the environment interact during the development of schizotypal personality disorder. This is also the case for the dramatic and erratic personality disorders of Cluster B, which we will discuss in the next section of this module.

Cluster B Personality Disorders: Dramatic and Erratic Behaviours

Listen to the Audio

The general theme of Cluster B personality disorder is emotional intensity. Although the four Cluster B disorders differ in the types of emotions that are expressed, each one can involve emotional outbursts that impair normal social functioning.

Borderline Personality Disorder

Listen to the Audio

One of the clearest examples of the emotional dysfunction that lies at the core of personality disorders is found in **borderline personality disorder (BPD)** *which is characterized by intense extremes between positive and negative emotions, an unstable sense of self, impulsivity, and difficult social relationships*. People with BPD experience a wide range of emotions, including extremely positive states such as joy, excitement, and love, but also very powerful destructive emotions such as anger, despair, and shame.

Their relationships are characterized by instability and intensity, possibly due to the fact that the medial frontal lobes—brain areas related to the regulation of attention and emotional responses—are smaller than in healthy controls (Denny et al., 2016). A person with BPD may fall in love quickly and passionately, but also be highly fearful of abandonment and thus react intensely to any sign of rejection or criticism, quickly becoming disgusted with and rejecting their partner. They are often highly manipulative in relationships, attempting to keep the person under their control. In fact, their emotional reactions and ability to be emotionally manipulative in relationships are so strong that therapists typically limit themselves to a very small number of clients with BPD.

It is believed that borderline personality disorder arises out of the person's attempts to deal with deeply rooted insecurity and severe emotional disturbances that are ultimately rooted in emotionally difficult

experiences, such as inconsistent, abusive, or neglectful parenting. To cope with or escape from negative emotions, the person often engages in impulsive, risky, or self-destructive behaviour, including substance abuse, indiscriminate sex, self-injury such as cutting or burning oneself, and even suicide (American Psychiatric Association, 2013; Linehan, 1993).

Narcissistic Personality Disorder

Listen to the Audio

Narcissistic personality disorder (NPD) *is characterized by an inflated sense of self-importance and an excessive need for attention and admiration, as well as intense self-doubt and fear of abandonment*. So, NPD has two sides that appear contradictory. One part is focused on self-enhancement and ensuring that attention is focused on them, while the other consists of a fragile ego that is extremely sensitive to criticism.

Behaviourally, the central focus on the narcissistic person's own feelings and self-importance leaves little room for empathy for others. Instead, they tend to be manipulative and put themselves first, ensuring their own needs are met in their relationships regardless of the toll it takes on others. In many public situations, such as school, people with NPD have a strong sense of entitlement, believing that people should satisfy their demands, and being likely to do whatever it takes, including cheating, in order to ensure their own success (Brunell et al., 2011). Recent neuroimaging studies suggest that these behaviour patterns may be due to disruptions of a frontal-lobe circuit involved with empathy (Schulze et al., 2013). This result would be consistent with the symptoms seen in the clinic (and in some U.S. government offices).

According to Greek mythology, Narcissus discovered his image reflecting on the surface of a pool of water. Unable to tear himself away from the beauty of his own face, Narcissus wasted away and died at the water's edge. In modern times, narcissism describes a person who has an inflated sense of self-importance.

Narcissus, c.1597-99 (oil on canvas), Caravaggio, Michelangelo Merisi da (1571–1610)/Palazzo Barberini, Rome, Italy/Bridgeman Images

Histrionic Personality Disorder

Listen to the Audio

Emotional dysfunction can also be seen in **histrionic personality disorder (HPD)**, *which is characterized by excessive attention seeking and dramatic behaviour*. “Histrionic” comes from a Latin word meaning “like an actor or like a theatrical performance”—an apt label for this disorder. People who have HPD are typically high-functioning because their dramatic nature makes them seem vibrant and attractive in social situations, and they readily use flirtatiousness, sexuality, and flattery to garner the social attention they crave. Similar to the other personality disorders discussed in this section, the histrionic person often engages in indulgent and risky behaviours, and tends to be highly sensitive to criticism and generally manipulative in relationships. The key difference between HPD and the other personality disorders in this cluster is the flamboyance and exhibitionistic tendencies in histrionic behaviour. HPD appears to have a strong genetic component. The heritability estimate of HPD is 0.63 (Torgersen et al., 2000). However, little is known about the specific genes or the brain areas underlying this personality disorder.

Antisocial Personality Disorder

Listen to the Audio

In contrast to histrionic personality disorder, which is associated with dramatic behaviour, the diagnosis of **antisocial personality disorder (APD)** is given to individuals who have a *profound lack of empathy or emotional connection with others, a disregard for others' rights or preferences, and a tendency toward imposing their own desires, often violently, onto others regardless of the consequences for other people or, often when younger, animals*. APD tends to be highly resistant to treatment, in part because individuals with APD are not alarmed or distressed by their actions (although others frequently are), and they are thus rarely, if ever, motivated to change.

Adults with APD and children with *conduct disorders* (often a precursor to APD) have difficulty learning tasks that require decision making and following complex rules. Brain imaging studies show that children with conduct disorders perform worse at these tasks and have reduced activity in the frontal lobes compared with healthy controls and even children with ADHD (Finger et al., 2008). Thus, it appears that cognitive factors and underlying brain systems are involved in personality disorders.

Troubled homes and communities can contribute to the development of antisocial personality disorder (Meier et al., 2008). People with APD have often experienced trauma or abuse. A history of being treated as an object rather than as a sensitive human being has consequences. The need to defend the self against intensely negative emotions and experiences may effectively shut down (or impair the development of) the emotional

circuitry for empathy. This often results in aggression and cruelty toward others, including animals.

Working the Scientific Literacy Model

The Criminal Psychopath

Listen to the Audio

Although the descriptions of APD bring to mind images of violent criminals, this is not always the case. Ironically, many of the characteristics of APD may themselves be highly desirable, or at least useful, in some professions (Dutton, 2012). The ability to emotionally detach from people, to be manipulative and able to deceive or lie without any moral reservations, to be charming and charismatic so as to appear to connect with people even though you can easily see people as tools to be used to satisfy your own desires, may well be rewarded in the worlds of CEOs, lawyers, salespeople, and undoubtedly many other social environments (Babiak & Hare, 2006). But one subset of people with APD are in fact violent criminals, and have captured the morbid imagination of movie-goers for decades: the criminal psychopath.

What do we know about psychopaths?

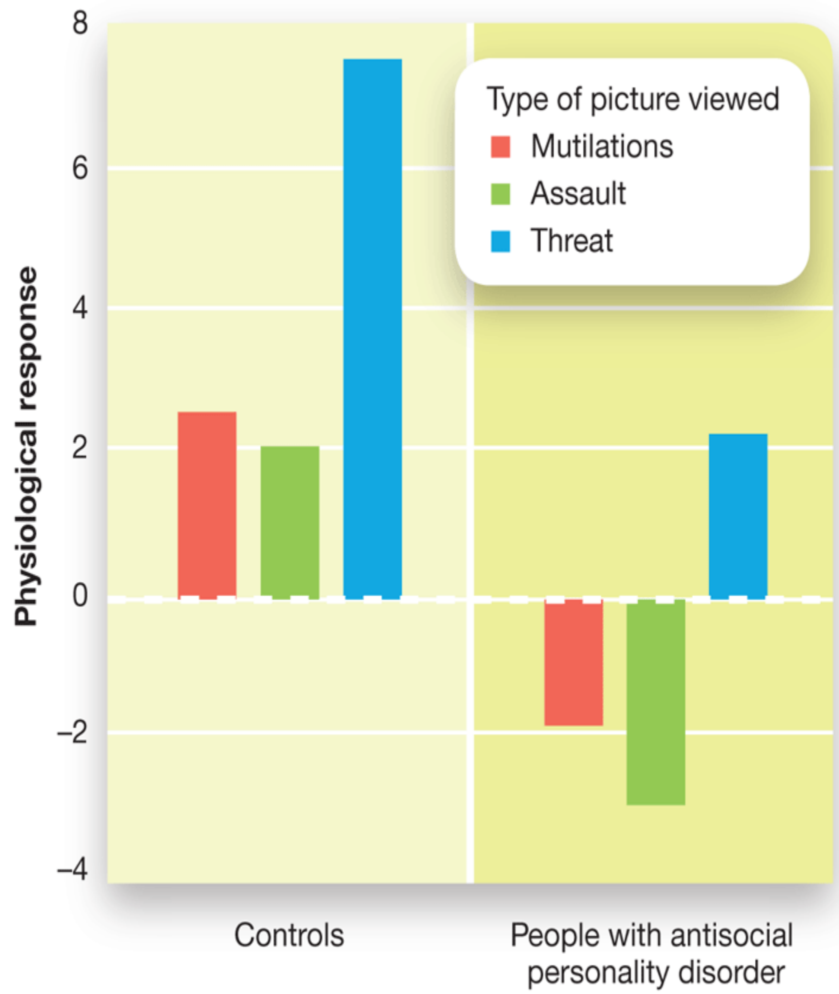
Although the term *psychopath* often gets used as a synonym for APD, there are some differences between the two. Approximately 15% to 20% of people with APD would also be diagnosed with psychopathy (Ogloff, 2006). Psychopaths are frequently diagnosed using the Hare Psychopathy Checklist-Revised (PCL-R; Hare, 2003), a 20-item checklist on which an assessor decides the degree to which a patient matches different characteristics.

The PCL-R breaks down into two main factors. The Interpersonal/Emotional factor contains items such as "superficial charm," "pathological lying," "lack of empathy," and "lack of guilt." The Social Deviance factor contains items such as "need for stimulation," "impulsivity," "poor behavioural controls," and "early behavioural problems." People with APD (but who are not psychopaths) tend to score highly on the Social Deviance items. Psychopaths, on the other hand, score high on both factors, but are particularly high on the Interpersonal/Emotional items. This result has led some psychiatrists to suggest that psychopathy is an extreme form of APD (Coid & Ullrich, 2010).

How can science explain psychopaths' behaviours?

You may have heard stories of people who have snapped under stress and committed horrific acts—however, this type of extreme stress response does not at all characterize psychopaths. In fact, researchers have discovered that psychopaths are *under*-reactive to stress. For example, a flash of light, a loud sound, or the sudden appearance of an angry face will startle most people. In contrast, psychopaths show very weak startle responses when exposed to unpleasant stimuli. In one study, researchers recorded the electrical signals of the eyeblink muscles while presenting disturbing images to a group of male prisoners from an American jail and a control group (i.e., without a psychological disorder). Figure 15.3 illustrates the results—the strength of the startle response is indicated by the height of the bars. The psychopaths (the bars on the right side) had much weaker responses than the control group (on the left; Levenston et al., 2000).

Figure 15.3 Emotional Responses of Psychopaths



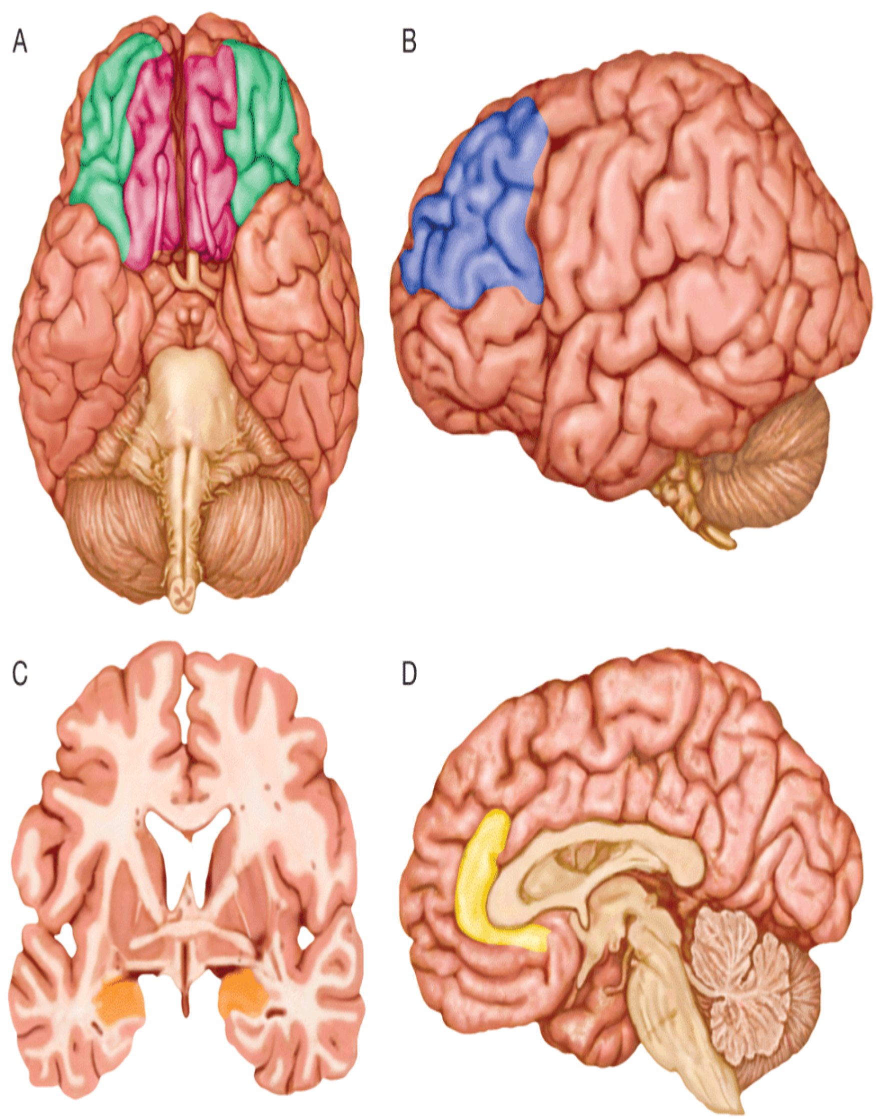
This graph shows the strength of autonomic response to three types of pictures: mutilations, assault, and threat. Responses are much greater among healthy control subjects (the three bars on the left) than among psychopaths (the three bars on the right).

Source: Adapted from Levenston, G. K., Patrick, C. J., Bradley, M. M., & Lang, P. J. (2000). The psychopath as observer: Emotion and attention in picture processing. *Journal of Abnormal Psychology*, *109*(3), 373–385.

This reduced reactivity to stress is due, in part, to abnormalities in the amygdala (Blair, 2010; Pemment, 2013). In most people, the amygdala fires in response to aversive stimuli. It is also involved with aversive conditioning, a form of emotional learning (see Module 6.1). However psychopaths show very little amygdala activity in these situations. Additional impairments

occur as a result of problems associated with the frontal lobes. The frontal lobes have connections that allow them to reduce the activity of the amygdala and other emotion-related brain regions (see Module 11.4). Psychopaths, however, have less grey matter in many frontal lobe regions (Yang et al., 2010). They also have less efficient white-matter pathways connecting the frontal lobes and amygdala (Craig et al., 2009). As a result, they have trouble regulating their emotional responses (see Figure 15.4).

Figure 15.4 Emotion Regulation in the Brain



In healthy brains, regions of the frontal lobes (highlighted in parts A, B, and D) are able to inhibit the activity of emotion-related structures such as the amygdala (C). In APD, less inhibition occurs, thus resulting in problems with the regulation of emotions.

Can we critically evaluate this information?

These explanations of psychopathy show us how these individuals *react* to emotional stimuli and events. But these data don't explain how psychopaths can manipulate others for their own goals. A neuroimaging experiment using prisoners in Germany, 14 of whom were psychopaths and 14 of whom weren't, provides an eerie window into the mind of the psychopath (Sommer et al., 2010). In the study, all participants viewed cartoon drawings in which a character's goals were fulfilled or unfulfilled. For instance, if a character named Max wanted to throw the ball to a character named Lena, Max's goals would be fulfilled when he did in fact throw the ball to Lena. His goals would be unfulfilled if he (for some reason) threw the ball to someone else instead. After viewing each cartoon, the participants were asked to indicate if the main character (i.e., Max) would feel happy, sad, or neutral.

As would be expected from a very simple task like this, both psychopaths and non-psychopaths answered almost all of the items correctly. There was a large difference in the neural activity that was occurring while they were responding, however. The criminals who were not psychopaths showed increased brain activity in brain areas related to empathy, indicating that they were mentally taking the perspective of the characters. The criminal psychopaths, on the other hand, showed increased activity in frontal-lobe areas related to outcome monitoring and attention. This activity was particularly high in response to the

instances in which the character's goals were not fulfilled. These results suggest that in situations when most people are empathizing, criminal psychopaths are planning.

Why is this relevant?

Identifying how physiology and brain function differ in psychopaths is certainly helpful for psychologists who are trying to understand the underlying mechanisms of these disturbing behavioural patterns. Psychopaths, and people with APD in general, tend to be highly resistant to psychological therapies, making it even more critical to understand the underlying biological processes. Also, antisocial patterns are often detectable during childhood and adolescence, which are critical periods of brain development. If a system of early diagnosis and treatment could be instituted, it might be possible to more effectively intervene before the person develops the full manifestation of the disorder, and before they commit any harm.

Cluster C Personality Disorders: Anxious and Fearful Behaviours

Listen to the Audio

The general theme of Cluster C personality disorders is anxiety. How this nervousness affects observable behaviours is what differentiates these different mental illnesses.

Avoidant Personality Disorder

Listen to the Audio

Most people have experienced the fear that someone will reject them. However, this fear does not usually become a person's most noticeable trait. In **avoidant personality disorder (AvPD)**, *individuals avoid social interactions, including those at school or work, because they feel inadequate and are deeply afraid of being rejected*. People with AvPD tend to avoid trying new things because they are afraid of embarrassing themselves. They also tend to focus on any criticism they might receive, even if it is quite minor. In some cases, people with AvPD will try to protect themselves against the pain of rejection by trying to avoid experiencing emotions altogether (Lampe & Malhi, 2018). To do this, they avoid forming social bonds.

Given the central role that fear plays in the lives of people with AvPD, it should come as no surprise that the amygdala is one of the structures believed to be involved in this disorder. Researchers have found that the amygdala showed larger responses in AvPD participants than in healthy controls when they were asked to judge the emotionality of negative social stimuli (Denny et al., 2015). Importantly, the size of the amygdala response during the study was positively correlated with their anxiety levels (i.e., as amygdala activity increased, so did self-reported anxiety).

Dependent Personality Disorder

Listen to the Audio

Individuals with **dependent personality disorder (DPD)**, *have an excessive need to be taken care of, often requiring frequent assurance from others and help with everyday decision making*. People with DPD have difficulty starting projects on their own because they lack confidence. They are also so afraid of being abandoned that they tend to avoid disagreeing with others.

There are some similarities between DPD and AvPD. The fear of being rejected dominates the lives of people with these disorders. What separates the two conditions is that people with AvPD tend to avoid social relationships so that they will not experience rejection, whereas individuals with DPD become excessively clingy to people in their social network because they are afraid of being rejected (Lampe & Malhi, 2018).

Obsessive-Compulsive Personality Disorder

Listen to the Audio

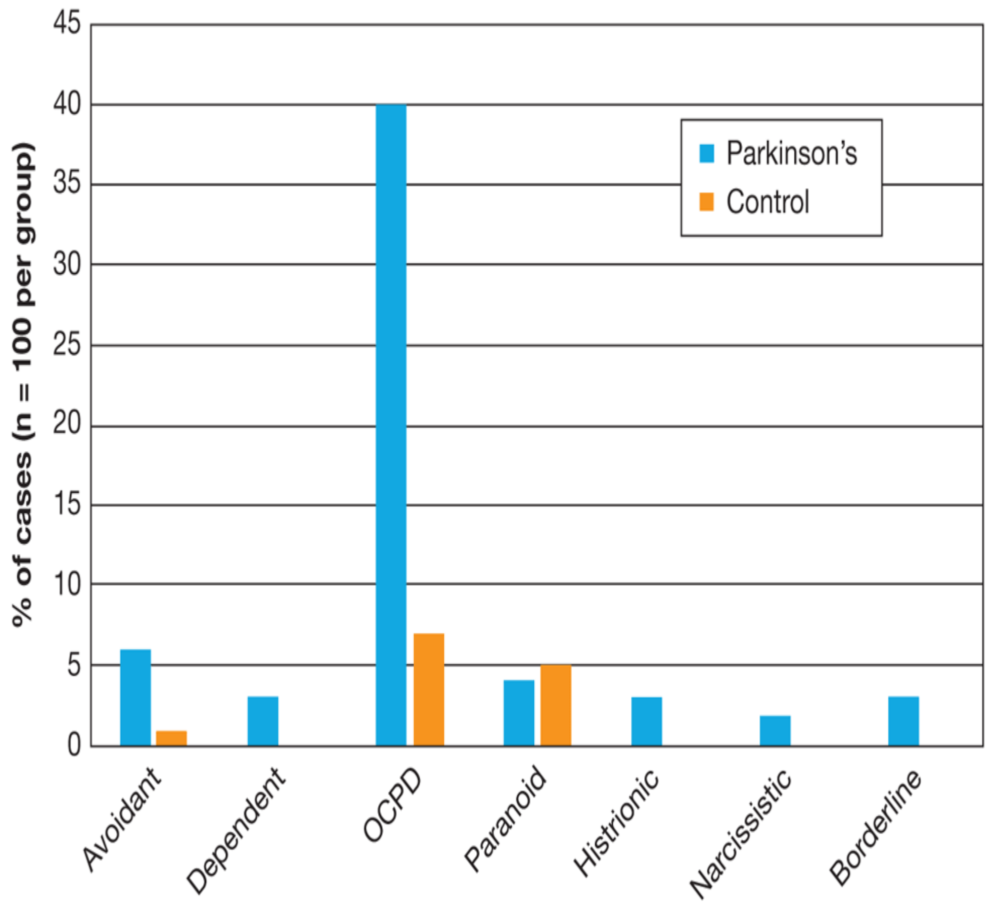
The final personality disorder listed in the DSM-5 is **obsessive-compulsive personality disorder (OCPD)**, *a disorder in which individuals are perfectionists who are unusually focused on details, organization, and productivity; these individuals also tend to avoid spending money or throwing out old, worthless objects*. This is a personality disorder that many people diagnose themselves with because they see similarities between this disorder and their own organized selves. However, OCPD is not just being organized. It involves a maladaptive focus on details that causes distress in their lives.

The DSM-5 provides an excellent example of OCPD that is quite relevant to the lives of students. Someone with OCPD will make a detailed list of what needs to be done. But she will spend so much time trying to complete each item on the list "perfectly" that some items are not completed. So, a lab report will be rewritten several times in an attempt to make it perfect. As a result, the deadline for submitting an essay in another class will be missed. People with OCPD often fail to delegate tasks and refuse help from others because they feel that other people will not produce "perfect" work.

OCPD also involves stingy spending habits with a focus on saving money and not throwing away old items. As in their work life, the focus here is on control. If they control money now, they will be prepared if a catastrophe occurs at a later time.

There have been relatively few studies of the biology underlying OCPD. However, Italian researchers performing research on *Parkinson's disease*, a movement disorder caused by damage to dopamine-producing brain areas, noted that OCPD occurred in 40% of their patients (Nicoletti et al., 2013; see Figure 15.5). No other personality disorder exceeded 10%. This result suggests that this disorder is related to the neurotransmitter dopamine.

Figure 15.5 Personality Disorders in Patients with Parkinson's Disease



Parkinson's disease is a movement disorder caused by damage to dopamine systems projecting to the basal ganglia in the brain. In one study, 40% of patients with Parkinson's disease also had OCPD, suggesting that this personality disorder involves dopamine-releasing brain regions.

Source: Adapted from Nicoletti et al. (2013). Obsessive compulsive disorder and Parkinson's disease. *PLoS ONE*, *8*(1), e54822.

At this point of the module, you have read about the 10 personality disorders listed in the DSM-5. However, there is one personality-related mental illness that has not yet been discussed. This disorder is what happens when a person's problems are not due to the characteristics of their personality, but to the presence of more than one personality in the same brain.

Dissociative Identity Disorder

Listen to the Audio

Have you ever been so engaged in driving, reading a book, or playing a game that you were totally unaware of what was going on around you? Have you ever had difficulty determining whether an event, perhaps some long-ago story, really happened the way you now remember it, or whether it was a story that happened to someone else, or even a dream? These types of experiences can be thought of as dissociative experiences, because they are characterized by a sense of separation (dissociation) between the person and their surroundings. Dissociative experiences may arise while you are intensely focused on one activity, or when you drift off while not doing anything in particular, such as daydreaming during a long lecture. People differ in their tendencies to dissociate, but such experiences seem completely normal. In contrast, dissociative states caused by brain injury or psychological trauma are far from harmless.

What Is Dissociative Identity Disorder?

Listen to the Audio

In a few cases, some people have such extreme dissociative experiences that they may be diagnosed with a **dissociative disorder**, *a category of mental disorders characterized by a split between a person's conscious awareness and their feelings, cognitions, memory, and identity* (Kihlstrom, 2005). These disorders can be caused by brain damage or psychological trauma and may occur at the same time as other psychological disorders.

The best known member of this category is **dissociative identity disorder (DID)**, *in which a person experiences a split in identity such that they feel different aspects of themselves as though they were separated from each other. This can be severe enough that the person constructs entirely separate personalities, only one of which will generally be in control at a time*. This is also sometimes referred to as **multiple personality disorder**.

In most cases, dissociative disorders such as DID are thought to be brought on by extreme stress (Putnam, 1989). Some psychologists have hypothesized that during a traumatic event such as being a victim of violence, individuals may cope with the experience by shifting their consciousness to a different perspective. They may go to another place in their mind, or feel as though they are separate from their physical bodies and are watching events happen to them as though their body was a different person. With repeated experiences, this type of dissociation could become an individual's habitual way of coping with trauma, as well as other stressful situations (van der Kolk, 1994).

Is Dissociative Identity Disorder "Real"?

Listen to the Audio

DID is a very rare condition, affecting only about 1% of psychiatric patients, and therefore only a very small fraction of 1% of the general population (Rifkin et al., 1998). There has been longstanding controversy surrounding whether DID is real. Many of the characteristics of different alters could be faked by people who explicitly (i.e., on purpose) adopt different personas, undergo hypnosis, or are simply influenced by the expectations of psychologists. Importantly, in many of these cases, the different alters begin to *feel* real to the patient (even if they began as inventions). This makes it quite challenging for researchers attempting to test whether DID really exists.

One approach to testing for DID is to check for memory dissociations between alter identities. For example, in one study, patients viewed words and pictures and were tested for recall of the stimuli either when they were experiencing the same alter as when they learned them, or when they were experiencing a different alter. The results suggested that some types of learning do not transfer between alter identities (Eich et al., 1997). This finding would suggest that the alters are truly separate.

A cause for concern related to the diagnosis of DID is the huge change in the number of cases reported over time. By 1970, there were only 79 documented cases of DID (then referred to as multiple personality disorder). In 1986, there were around 6000; by 1998, the number had risen to more than 40 000 (Lilienfeld & Lynn, 2003). Also, 80% of patients

diagnosed with DID were unaware of having the disorder before starting therapy (Putnam, 1989). These observations suggest that DID may have its origins in the context of therapy, rather than being a response to trauma. Also of note, the number of alters changed dramatically. In the early decades up to the 1970s, a person would typically have only one alter; but by the 1980s, people were identified as having many different alters, even dozens or hundreds!

Why did the rate of DID skyrocket from 79 cases to more than 40 000 cases in fewer than three decades? This increased prevalence could simply be a product of awareness: After professionals learned how to identify the disorder, they could begin to diagnose it more effectively. Or, it may be that a small subset of psychologists find the disorder compelling and are more willing to diagnose it, so they interpret symptoms through that framework, and may (even unintentionally) provoke dissociative symptoms in the context of therapy (Frankel, 1993). The use of highly suggestive techniques such as hypnosis increases the likelihood that this is the case.

Module 15.2 Summary

Listen to the Audio

15.2a Know . . . the key terminology associated with personality and dissociative disorders.

Review Module 15.2

Start Over Swap

0/14 REVIEWED · 0 MASTERED

paranoid personality disorder (PDP)

Previous Next Got It!

15.2b Understand . . . how different types of personality disorders can affect interpersonal relationships.

Many personality disorders have negative effects on interpersonal relationships. The Cluster A disorders (paranoid, schizoid, and

schizotypal) generally involve unusual ways of interpreting social situations. This can lead to difficulties in accurately communicating with other people. Cluster B disorders (borderline, histrionic, narcissistic, and antisocial) often involve emotional intensity. These disorders often lead to explosive relationships, with fighting and drama. Cluster C disorders (avoidant, dependent, and obsessive-compulsive) hamper relationships because people with these disorders are quite anxious and attempt to find ways to control relationship (by being clingy or demanding, or by avoiding them altogether). In each case, you can see how personality disorders lead to social difficulties.

15.2c Apply . . . your knowledge of personality disorders to identify which maladaptive behaviour is consistent with each disorder.

Apply Activity

Please match the disorder to the behaviour for the following six examples:

Jennica always spoke loudly and loved to be the centre of attention, even when it was not an appropriate situation to act this way.	Histrionic Personality Disorder
Alesha was so focused on making sure that her report for work was perfect that she ended up not finishing another assignment.	Obsessive-Compulsive Personality Disorder
Deanna's friendships were all very intense, sometimes involving incredibly fun evenings and other times involving bitter arguments.	Borderline Personality Disorder
Matthew had a history of getting into fights. Although he seriously hurt someone, he felt no remorse and saw no reason to alter his behaviour.	Antisocial Personality Disorder
Donald believed that he was smarter than the people he worked with and became quite angry whenever anyone criticized any of his ideas.	Narcissistic Personality Disorder
People often had trouble understanding what Iris meant when she spoke. She often talked in abstract ways that didn't always make sense.	Schizotypal Personality Disorder

Check Your Understanding

15.2d Analyze . . . the status of dissociative identity disorder as a legitimate diagnosis.

The lack of a physical basis for the disorder and its unusual rate and patterns of diagnosis bring about skepticism as to whether DID is real or is manufactured, perhaps unwittingly, by the person. It is important to find evidence for differences between alternate personalities that cannot be faked by people or created artificially. Recent research in brain imaging is beginning to look for different patterns of neurological activity that could denote distinct personalities, but this work is in its infancy.

Module 15.3 Anxiety, Obsessive–Compulsive, and Depressive Disorders

Listen to the Audio

Jeffrey T Barnes/AP/Shutterstock

Learning Objectives

15.3a Know . . . the key terminology related to anxiety, obsessive–compulsive, and depressive disorders.

15.3b Understand . . . the different types of anxiety disorders.

15.3c Understand . . . how anxiety or depressive disorders can be self-perpetuating.

15.3d Apply . . . your knowledge of anxiety, obsessive-compulsive, and depressive disorders in order to identify which behavioural symptoms are associated with each disorder.

15.3e Analyze . . . whether maladaptive aspects of specific phobias might arise from perfectly normal, healthy behaviours.

On March 29, 2018, over 18 000 hockey fans at Buffalo's KeyBank Arena watched Sabres goaltender Robin Lehner's life change. The night before the game, Lehner was experiencing intense panic, although he couldn't explain exactly what was causing the unpleasant emotions. He let the team's trainers know that he wasn't feeling great and might not be able to start in net that night. But when he got to the arena to talk to them, he decided to battle through his feelings and play. It was a mistake. By the end of the second period, Lehner was experiencing intense chest pain and blurred vision. He barely made it to the dressing room after the second period. It was clear to everyone that he needed help.

During a lengthy treatment, Lehner was diagnosed with bipolar disorder—an illness involving alternating periods of depression and bouts of manic energy—as well as an anxiety disorder and a substance abuse disorder. He spent over two months at a treatment facility in Arizona working hard to overcome his substance abuse problems and learning to cope with his depression and anxiety. His contract with the Buffalo Sabres had ended that season and it was unclear what his

future held. But his family supported him (and he remained in contact with former teammates and Sabres management). In the summer of 2018, Lehner was offered a contract with the New York Islanders. He had made it back from the edge.

Lehner described his difficulty journey in a letter to the online sports magazine The Athletic. *(The full letter is available online and is worth reading). Being so open about his mental illness and his journey to recovery was very challenging, particularly for someone in a "macho" sport like hockey. He decided to discuss his problems because he thought it would help other people who are struggling with psychological disorders like depression and anxiety. In June 2019, he received the Bill Masterton Memorial Trophy, an award given to the NHL player who showed perseverance, sportsmanship, and dedication to hockey. In his heartfelt acceptance speech, Lehner said, "I'm not ashamed to say I'm mentally ill." Being mentally ill does not mean you are mentally weak.*

Anxiety and mood disorders are extremely common. In fact, a recent survey of over 10 000 Ontario students in grades 7 through 12 found that 46% of females and 23% of males reported suffering from depression and/or an anxiety disorder (Boak et al., 2015). These staggering statistics show how prevalent these disorders are. Importantly, they also show those suffering from anxiety or depression that they are not alone—other people truly *can* understand how they feel.

Anxiety Disorders

Listen to the Audio

Anxiety disorders are *a category of disorders involving fear or nervousness that is excessive, irrational, and maladaptive*. They also are among the most frequently diagnosed disorders affecting approximately one in every eight Canadians (Statistics Canada, 2013). They often co-occur with other disorders, such as depression or obsessive–compulsive disorders, substance abuse, or problematic behaviour patterns such as an excessive need to be in control of situations.

Although occasional experiences of anxiety are normal, functional responses to life circumstances, when anxiety becomes debilitating and interferes with the person's daily life, it becomes a problem. People often attempt to cope with anxiety by limiting themselves to environments, activities, and people that make them feel safe and secure, and by developing rigid habits and ways of doing things that keep life predictable and under control. These patterns evolve in order to help anxious people manage their fear, but they also can limit people's freedom to live their lives as they would like.

In most people's experience, anxiety occurs as a natural part of the fight-or-flight response (Nesse & Ellsworth, 2009). We experience this response as a racing, pounding heartbeat with increased respiration, as our autonomic systems prepare our bodies for quick action. Some people may notice a knot in the stomach and sweaty or clammy hands. These physical changes reflect a shift in energy away from non-emergency tasks

like digestion and toward fighting or fleeing. This basic fight-or-flight response seems to be common to all mammals, implying that it has long been evolutionarily adaptive to have an easily triggered system that can quickly arouse the body for action. However, living in our modern, stressed-out society, we activate this stress response system repeatedly throughout our days, to the point where it can become harmful to us (see Module 14.2). At the same time as the fight-or-flight response, the brain's attentional networks are directing more resources toward the negative, anxiety-related thoughts and stimuli than to neutral or positive ones (Ghassemzadeh et al., 2019). This further increases an anxious person's tendency to focus on their own anxiety.

Varieties of Anxiety Disorders

Listen to the Audio

What separates anxiety *disorders* from normal experiences of anxiety is the intensity and long duration of the response. Anxiety disorders are also distinct in that the response may not be directly connected to a person's current circumstances; instead, the anxiety can be free-floating. Either way, anxiety disorders cause a great deal of emotional distress and interfere with people's daily lives. Of course, not all anxiety disorders are the same. Psychologists have identified distinct patterns of experience that have given rise to several major types of anxiety disorders.

Fight or flight . . . or freeze or faint? In addition to fight-or-flight responses, mammals can also react by freezing—as in the "deer in the headlights" response—or by fainting, as some will do at the sight of blood (Bracha et al., 2004).

Darren Bridges Photography/Alamy Stock Photo, Dlewis33/Getty Images

Generalized anxiety disorder (GAD) *involves frequently elevated levels of anxiety, generally from the normal challenges and stresses of everyday life*. A person with GAD fears disaster lurking around every corner, and may experience symptoms ranging from difficulty sleeping or breathing to difficulty concentrating because of intrusive thoughts. However, because the anxiety arises out of the ongoing situations and circumstances of life, people often have difficulty understanding their experience and cannot identify specific reasons for which they are anxious (Turk et al., 2005). It is also difficult to resolve the anxiety, despite attempting to control situations and trying to attend to every detail so that nothing goes wrong. Instead, as one detail is dealt with, the anxiety shifts to another source, and the control-oriented person is locked into a never-ending scramble to manage life perfectly so as to keep anxiety at bay.

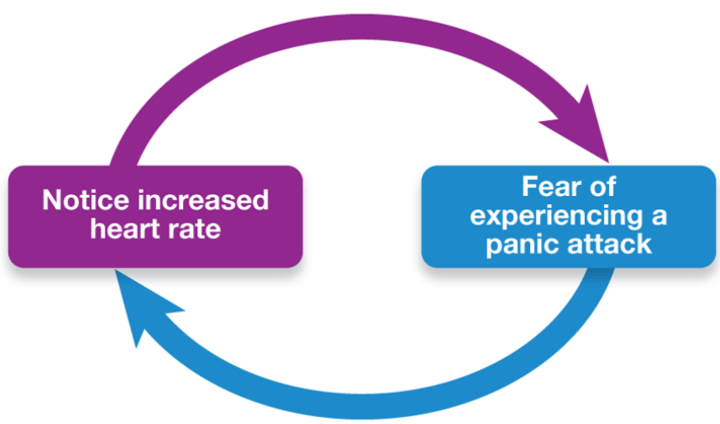
Not surprisingly, people with GAD often have unstable, irritable moods and experience difficulty concentrating. Although there are many factors that increase the probability of developing GAD, ranging from innate, genetic components to current habitual thinking patterns, a convergence of stresses, such as occurs during major life changes, commonly precede the onset of the disorder (Newman & Llera, 2011). Brain imaging studies suggest that this sensitivity to stressors is related to the fact that the right amygdala is larger and more responsive to emotional stimuli in people with GAD (Makovac et al., 2016; Monk et al., 2008). These individuals also show larger neural activity in response to making a mistake during a task (Weinberg et al., 2010). All of these neural differences correlate with the severity of the GAD symptoms.

Panic disorder is *an anxiety disorder marked by occasional episodes of sudden, very intense fear*. This condition is distinct from GAD because the anxiety occurs in short segments but can be much more severe. The key

feature of this disorder is **panic attacks**—*brief moments of extreme anxiety that include a rush of physical activity paired with frightening thoughts*. This is what goaltender Robin Lehner experienced on the ice in front of 18 000 people. A panic attack escalates when the fear causes increased physical arousal, and the increased physical symptoms feed the frightening thoughts. The escalation rarely goes on for more than 10 minutes, after which the individual will eventually return to a more relaxed state.

A substantial subset of people with panic disorder develop a recurring fear that the panic will strike again, particularly in an environment in which they would be exposed and unable to escape from people, such as a shopping mall or other public space. This creates a vicious cycle in which the fear of panicking creates more panic (see Figure 15.6). This fear can result in **agoraphobia**, *an intense fear of having a panic attack in public; as a result of this fear, the individual may begin to avoid public settings and increasingly isolate themself*. In its most extreme forms, agoraphobia leads individuals to stay inside their homes almost all the time.

Figure 15.6 The Vicious Cycle of Panic Attacks



Working the Scientific Literacy Model

Specific Phobias

Listen to the Audio

In contrast to GAD, where an individual's anxiety can be applied to just about any situation, a **phobia** is *a severe, irrational fear of a very specific object or situation*. Some of the most common phobias are listed in Table 15.2. Phobias are sometimes divided into two broad categories: specific phobias and social phobias. A **specific phobia** involves *an intense fear of a specific object, activity, or organism*. For example, the person may be afraid of specific animals, heights, thunder, blood, or injections or other medical procedures. Social phobias, which are also very common, are related to interpersonal situations and relationships and are discussed later.

Clinical researchers have identified five main categories of specific phobias. Most studies report that approximately 5% of the population is currently experiencing one or more of the natural environment, situational, animal, or blood/injection/injury phobias. Approximately 40–60% of the population has experienced one of these phobias at one time in their lives. The prevalence of "other types" of phobias is lower, with approximately 1% of the population currently experiencing this phobia and 10% having experienced at some point in their lives.

Table 15.2 Five Main Types of Phobias

Table 15.2 Five Main Types of Phobias

Type of Phobia	Examples
Natural environment type	Heights, thunderstorms, large bodies of water
Situational type	Closed spaces (e.g., elevators), crowds
Animal type	Spiders, snakes, mice
Blood/injection/injury type	Seeing blood or broken bones, seeing needles
Other type	Fear of vomiting or choking

Source: Information is derived from the Centre for Addictions and Mental Health (CAMH) (2019). Retrieved from https://www.camh.ca/en/health-info/mental-illness-and-addiction-index/phobias.

What do we know about phobias?

Phobias often develop as a result of unpleasant or frightening experiences; there's nothing like getting bitten by a dog to make a person afraid of dogs. That said, the overwhelming majority of the triggers for phobias are objects or situations that we may *need* to fear, or at least be cautious about. For example, people readily develop phobias of spiders, snakes, heights, and drowning—dangers that would have been important over the course of our species' evolution (Öhman & Mineka, 2001; see also Module 6.1). This tendency suggests that there may be a genetic component to some of our specific phobias. Of course, this does not mean that other phobias will be impossible to develop, but rather that people are more biologically predisposed to fear evolutionarily relevant objects or situations.

Interestingly, phobias can also develop without direct, personal experience. Why would a person develop an extreme fear about something that they had no personal experience with, especially if it was something that they, realistically, were unlikely to ever have personal experience with? It doesn’t seem rational, or functional. In some cases, these links form through observational learning, such as seeing vicious sharks in movies (see Module 6.3). In many of these cases, an initial mental link between an object or situation and an emotion can be retrieved from memory and thought about multiple times. We think about the object and become afraid. This fear can, in turn, become a retrieval cue for the object. The result of these feedback loops is that our brains can create powerful experiences, even though they are not real in the sense that they are not being triggered by anything actually happening in the external world at that moment; this tendency is known as *parasitic processing* (Vervaeke & Ferraro, 2012). Indeed, this is essentially how anxiety disorders, including phobias, work! The self-reinforcing nature of anxiety reactions leads them to grow and become more extreme over time (Merckelbach et al., 1996).

How can science explain why some people are more likely than others to develop specific phobias?

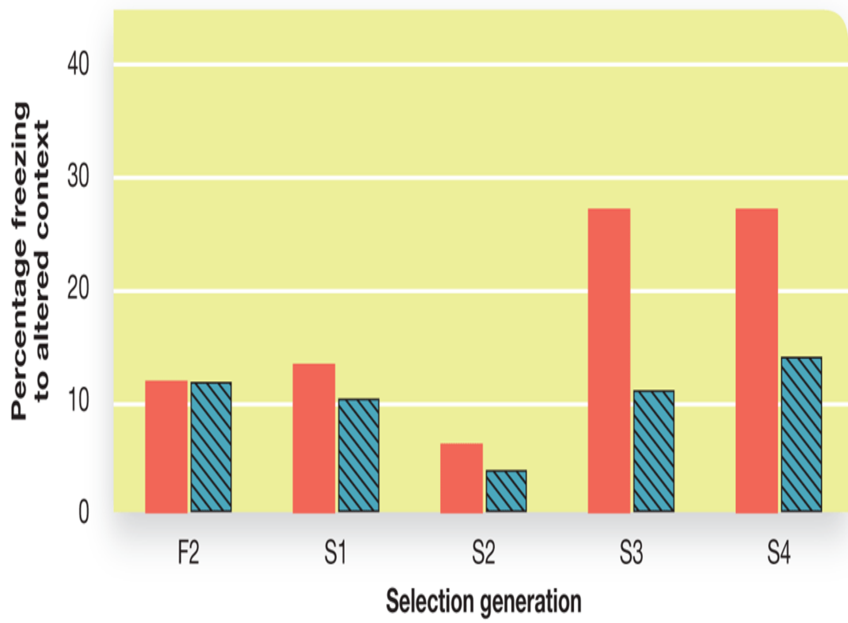
For any given individual, there are many factors that determine whether or not a phobia develops. For example, some of the risk factors for phobias include personality characteristics, like shyness and temperamental inhibition, both of which are, interestingly enough, partly genetically determined (Eaton et al., 2018).

Scientists have been piecing together the genetic factors that biologically predispose some people to experience more fear than

others. One of the first questions to answer is simply whether or not the tendency to learn fear associations can be transmitted genetically. One group of researchers attempted to answer this using selective breeding techniques with mice. The researchers tested a strain of mice for how easily they could learn a fear association (an auditory tone coupled with an electrical shock). The fear response was measured by the length of time the mice held still—mice typically show fear by freezing in place (Ponder et al., 2007).

By selectively breeding the most fearful mice with each other, and the least fearful mice with each other, researchers could see whether the fear-association response would differ across the generations of these mice families. As Figure 15.7 shows, across four generations, fear responses became more and more distinct, with the third and fourth generations being very different from each other. These patterns of behaviour diverging so substantially in different genetic pools suggests that the fear-based learning system is, at least in part, genetically determined.

Figure 15.7 Anxiety Levels Are Inherited in an Animal Model



Over the course of just a few generations, mice from the highly fearful genetic strain show increasingly strong fear responses as indicated by the height of the red bars. The blue bars represent the responses of a typical genetic strain of mice (i.e., the control group).

Source: From Ponder, C. A., Kliethermes, C. L., Drew, M. R., Muller, J. J., Das, K. K, . . . Palmer, A. A. (2007). Selection for contextual fear conditioning affects anxiety-like behaviors and gene expression. *Genes, Brain and Behavior, 6*: 736–749. Copyright © 2007 by John Wiley & Sons, Inc. Reproduced by permission of John Wiley & Sons, Inc.

Can we critically evaluate this information?

We may question the value of this research because, on the face of it, we don't seem to have learned much about phobias from studying genetic heritability of fear responses in mice. However, understanding that genes can influence fear responses in another mammalian species suggests that genes likely underlie our own reactions to threatening stimuli and situations. Therefore, behavioural genomics investigations of phobias could provide us with important information.

A second potential criticism of this research is that it only examines fear responses from one perspective: genetics. The

authors of those research papers would be the first to admit that the full manifestation of a phobia involves many processes and, therefore, would only be partially explained by a genetic understanding. For instance, observational learning likely plays a large role in the development and maintenance of phobias. Seeing another mouse (or human) react with fear to specific objects or animals would teach a young mouse (or human) that *that* object or animal is to be feared. The fact that multiple factors are involved in the development of phobias provides further support for the use of the biopsychosocial model when explaining behaviour.

Why is this relevant?

In general, understanding causal factors better, targeting causal mechanisms more effectively, and directly manipulating biological systems related to fear and anxiety responses sound like pretty good ideas. A challenge for the future is to understand the interaction between the genetic and other levels of analysis in order to fully develop these tools. Doing so may lead to new treatment for a number of disorders.

Social Phobia

Listen to the Audio

Thus far, our discussion of phobias has focused on fearful responses to specific stimuli such as snakes (or snakes with knives in their mouths). **Social anxiety disorder**, on the other hand, is *a very strong fear of being judged by others or being embarrassed or humiliated in public*. People who experience social anxiety deal with going out in public by developing familiar routines and retaining control over their ability to exit circumstances if their anxiety becomes too strong. Social anxiety generally leads people to limit their social activities in favour of not exposing themselves to anxiety, thus making it difficult to succeed and live a normal life in many different ways.

Consider the day of a university student who has social anxiety:

- This student always shows up to class just as it begins so he does not have to risk awkward conversations with classmates he does not know or, potentially worse, sitting conspicuously alone and being unable to connect to anyone around him.
- Despite being hungry, the student will not go into the cafeteria because his roommate is not around. He cannot face the prospect of sitting with strangers, especially without his roommate. He finds a quiet spot near the library and gets lunch from a vending machine.
- Walking across a quiet part of campus, he sees his professor approaching. Not knowing if the professor would recognize him, he wonders if he should say hello. Thinking about this issue makes him

so tense, he pretends to stop and read a text message to avoid eye contact.

As you can see, the day is a series of unpleasant, tense moments in situations that most people would find completely ordinary. It is also a series of sacrificed opportunities as the person fails over and over again to take advantage of chances for connection and social contact. The distress the student feels and the degree to which he shapes his life around his social phobia suggest that he has social anxiety disorder. Of course, to make a formal diagnosis of this disorder, a psychologist would need to evaluate the student's full set of symptoms and their duration.

Obsessive–Compulsive Disorder (OCD)

Listen to the Audio

Until 2013, *obsessive–compulsive disorder* was categorized as an anxiety disorder. In the DSM-5, this disorder was placed into its own diagnostic category and was discussed in a separate chapter. Doing so helped highlight the unique characteristics of a psychological disorder that consumes so much time and energy from those who experience it.

Characteristics of OCD

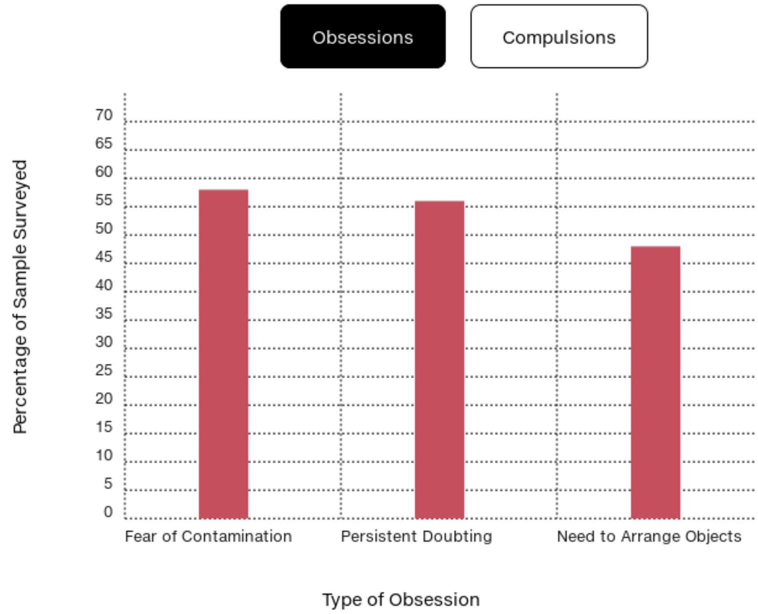
Listen to the Audio

Individuals with **obsessive-compulsive disorder (OCD)** tend to be *plagued by unwanted, inappropriate, and persistent thoughts (obsessions), and engage in repetitive, often quite ritualistic behaviours (compulsions)*. Generally, obsessions and compulsions are linked together, with the compulsive behaviour serving as a means of coping with the anxiety produced by the obsession (see Table 15.3). A person who is extremely concerned about germs and cleanliness has a common manifestation of OCD. They may wash their hands many times each day, insist on only touching other objects through gloves, or become extremely vigilant about the chemicals in food and cleaning products. Alternatively, someone who worries about starting a fire might develop compulsive checking behaviours. Before they can leave their house, they might check that all lamps and appliances are unplugged. They may make the rounds twice more, ensuring that the electrical cords are secured by fasteners at least two feet from the outlet. Finally, they might turn off the light to leave but, to avoid the possibility that the light switch is halfway between on and off, they might count out a series of one to seven in which they turn the light off repeatedly, followed by one last downward swipe to ensure the switch is fully off. Only then can they feel secure in leaving the house.

Table 15.3

Prevalence of Symptoms in People Diagnosed with Obsessive-Compulsive Disorder

Select *Obsessions* and *Compulsions* tabs below to see the prevalence of symptoms in a survey of 293 individuals with obsessive-compulsive disorder.



Source: Pinto et al., 2006.

Although everybody has unwanted thoughts that seem to stick in their heads from time to time, obsessions take root and can last for a very long time, even many years. Obviously, these thoughts tend to be distressing.

As these types of intrusive thinking patterns become more extreme and ever-present, they increasingly interfere with the person's life. Imagine people who obsessively think about cleanliness and germs. Everywhere they go in life, they encounter new microbiological terrors, forcing them to adopt elaborate rituals for how to sufficiently clean themselves and how to avoid making contact with germs in many different situations. Many psychologists believe that compulsive behaviours, and the relief they provide, give the person a feeling of control over their anxiety. They just have to perform a very *particular* behaviour in order to feel that control.

OCD and the Brain

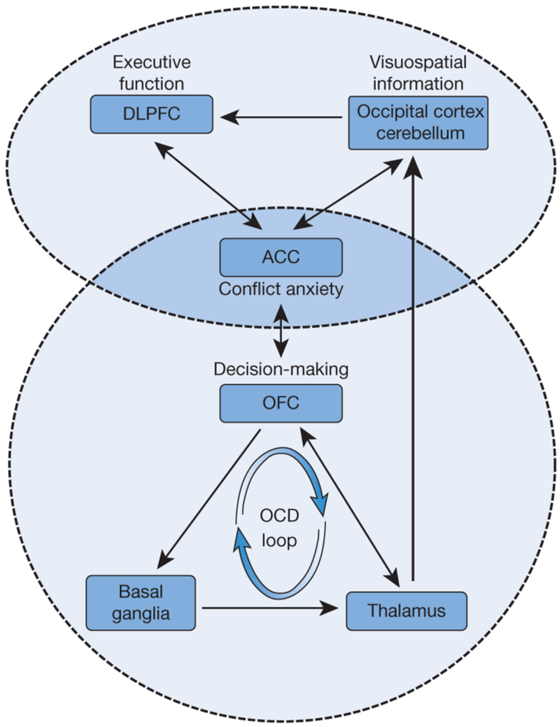
Listen to the Audio

The fact that OCD often involves a specific, repeated *action* suggests that the biology underlying this mental illness is different from that of anxiety disorders. Early studies suggested that OCD was due to a smaller orbitofrontal cortex (the part of the frontal lobes just above the eyes). This difference, in turn, influenced the efficiency of a brain network including the orbitofrontal cortex, parts of the basal ganglia, and the thalamus. This network has been called the *orbitofrontal loop* (Saxena et al., 1998). The orbitofrontal loop contains structures related to key features of OCD. The orbitofrontal cortex is involved in decision making, the basal ganglia are involved with movement and reward, and the thalamus is involved with taking in sensory information. This explanation for OCD provided an important starting point for understanding this mental illness.

More recent explanations for OCD built upon this earlier work and attempted to explain some of the cognitive symptoms that often accompany OCD, such as problems with working memory and attentional control. In this model of the disorder, OCD is still associated with a poorly performing orbitofrontal loop. But it also involves abnormal activity in other brain regions, including the dorsolateral prefrontal cortex, an area involved with attentional control and problem solving, and the anterior cingulate cortex, a frontal-lobe area that is involved in both attention and emotion (Menzie et al., 2008; see Figure 15.8). The weaker responses of these difference brain areas *may* explain the

behaviours of many patients with OCD. Importantly, as more research is performed, our understanding of the neural basis of OCD will become increasingly precise.

Figure 15.8 Obsessive–Compulsive Disorder and the Brain



OCD involves impairments in two “loops” in the brain. The orbitofrontal loop consists of the orbitofrontal cortex, basal ganglia, and thalamus. It is related to many OCD behaviours. A second neural “loop” or network consists of the dorsolateral prefrontal cortex, anterior cingulate cortex, and visual regions at the back of the brain. Dysfunction of this network is associated with many of the cognitive symptoms that occur in OCD, such as problems with working memory and attentional control.

Source: Adapted from Nakao, T., Okada, K., & Kanba, S. (2014). Neurobiological model of obsessive-compulsive disorder: Evidence from recent neuropsychological and neuroimaging findings. *Psychiatry and Clinical Neurosciences*, *68*, 587-605.

Mood Disorders

Listen to the Audio

Mood disorders are very common, affecting almost 10% of adults in Canada and the United States (Health Canada, 2012; Kessler et al., 2005). Due to a combination of biological, cognitive, and sociocultural differences, rates of depression are twice as high among women as among men, and three times as high among people living in poverty (Hyde et al., 2008). There is also a genetic susceptibility to mood disorders. In this section we discuss the two major types of mood disorders—major depression and bipolar disorder.

Characteristics of Major Depression

Listen to the Audio

Temporary feelings of sadness and depression are normal aspects of human experience. By comparison, **major depression** is *a disorder marked by prolonged periods of sadness, feelings of worthlessness and hopelessness, social withdrawal, and cognitive and physical sluggishness*. With this definition, it should be clear that depression involves more than just feeling sad for a long period of time. Cognitive activities such as concentrating and making decisions are affected as well, while memories shift toward unpleasant and unhappy events. Physiologically, affected individuals may be lethargic and sleepy, yet also experience insomnia. They may experience changes in appetite and the onset of digestive problems such as constipation or stomach aches.

To fully understand depression requires considering the cumulative, daily impact of life's activities being interfered with by feelings of despair, uselessness, and a lack of energy and motivation. Depression can lead to problems piling up at work and at home, relationships being strained or crumbling, and financial problems starting to interfere with daily life. People deep in depression may find it almost impossible to take care of more than the barest necessities of their lives. Their social lives suffer as they stop returning phone calls or emails. Other people may notice and get annoyed or have hurt feelings, which leads the depressed person to feel even worse about themself. These examples provide a glimpse of how depression can become such a monster.

Many people have experienced problems with a mood disorder. Those with depression may experience extended periods of sadness and hopelessness that have no apparent cause.

stefanolunardi/Shutterstock

Cognitive Aspects of Depression

Listen to the Audio

As a depressed person begins to emphasize negative, self-defeating, and self-critical thoughts, they develop a characteristic depressive or *pessimistic explanatory style* (Abramson et al., 1978; Sweeney et al., 1986). A person's explanatory style involves a set of cognitive habits that are important psychological precursors to depression. When faced with the inevitable negative events of life, people with a pessimistic explanatory style tend make the worst of them (instead of making the best of them), so to speak.

For example, when something bad happens, such as the person failing at a task or a project, they tend to make internal, *personal attributions* for the event, blaming themselves for what happened ("It's all my fault! I did everything wrong! I messed the whole thing up!"). Depressed individuals also tend to make *stable attributions*, assuming that the situation is going to persist ("It's always going to be like this. There is a fundamental problem, and it's never going to change."). And as they spiral into catastrophic ways of thinking, they make *global attributions*, expanding the impact of the negative event into other domains or into overall life ("I just can't do anything right; I'm going to mess up everything").

The pessimistic explanatory style adds stress and drains energy by constructing a more threatening or hopeless story for the individual. As a result, this explanatory style tends to predict a host of life outcomes from stress and health to success and relationships. To get a sense of how this

might work in specific events during a person's day, imagine an individual with depression who does something as minor as losing their keys; refer to Figure 15.9 to see the depressive explanatory style at work. Then extrapolate that same set of patterns across many different events throughout a person's life, and you will get a sense of the cumulative burden that this places on the individual.

Figure 15.9 Three Elements of the Depressive Explanatory Style

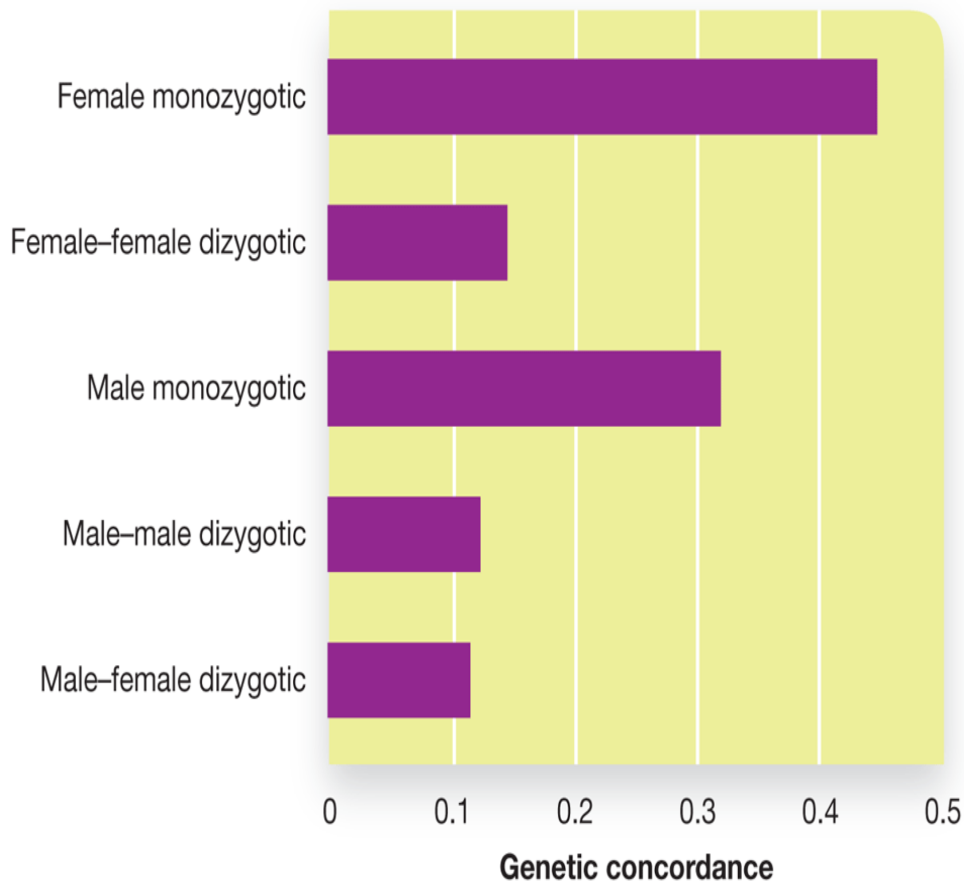
The three elements of the depressive explanatory style are internalizing, stabilizing, and globalizing.

Genetic Vulnerability to Depression

Listen to the Audio

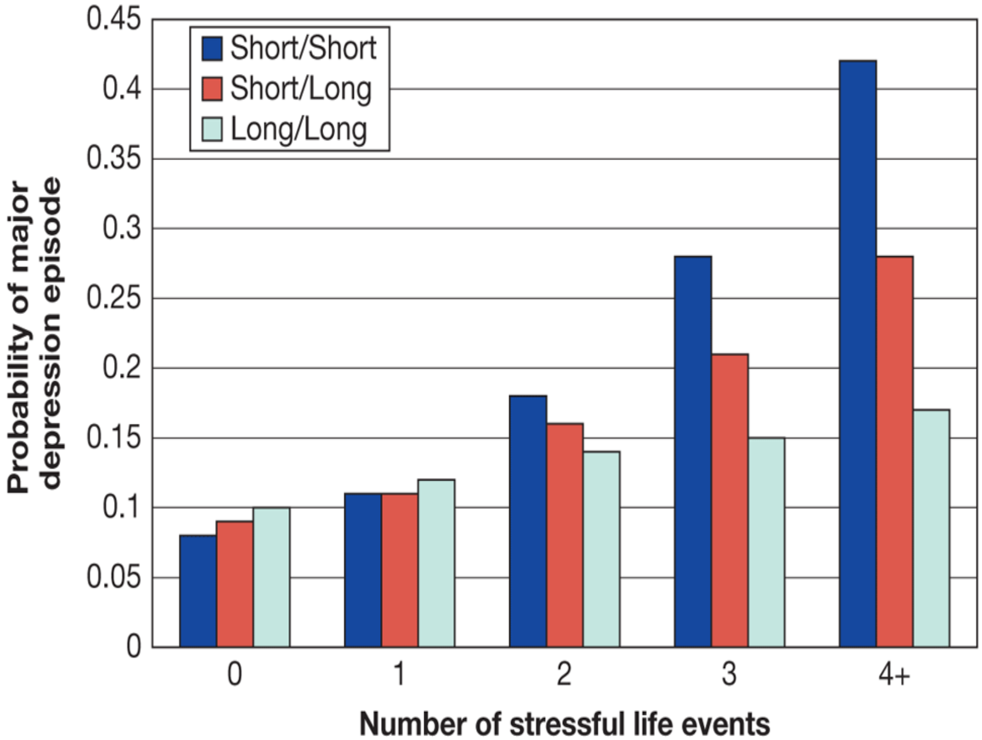
Research at the genetic level is also uncovering factors that contribute to the likelihood of being diagnosed with depression. Twin studies suggest an underlying genetic risk for developing major depression (Figure 15.10). Additionally, behavioural genetics researchers have found that people who inherit two copies of the short version of the 5-HTT gene are at greater risk for developing depression, whereas those who inherit two long copies are at a far lower risk (Caspi et al., 2003). But what is critical here is not just which genes are inherited, but also how much stress people experience. Figure 15.11 shows how this relationship works. As the number of major stressful life events increases, those who inherit two copies of the short version of this gene are far more likely to develop depression, whereas those who inherit two long copies are buffered from depression. People who inherit one copy of each gene (are heterozygous) show intermediate responses to stressful events. Notice that the type of serotonin gene inherited has no effect on depression after only one or two major stressful events. The gene–environment interaction becomes apparent after an *accumulation* of events. This *interaction between a genetic predisposition for a disorder and life stress* is known as the **diathesis–stress model** of psychological disorders (*diathesis* is Greek for “disposition” or “vulnerability”). It is just one of many examples of how nature and nurture interact.

Figure 15.10 Genetic Relatedness and Major Depression



Identical (monozygotic) twins have a greater chance of both developing major depression compared to fraternal (dizygotic) twins. Notice that the genetic correlation is highest for female monozygotic twins.

Figure 15.11 Gene and Environment Interactions in Depression



Stress interacts with genes and influences whether someone becomes depressed. People who inherit two copies of the short version of a gene that codes for serotonin activity in nerve cells are at an increased risk for becoming depressed in response to major life stressors. Those who inherit two long copies are buffered from becoming depressed as life stressors accumulate.

Source: Based on A Caspi et al., (2003) Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene, *Science, 301*(5631), 386–389. Reprinted with permission from AAAS.

Biological Aspects of Depression

Listen to the Audio

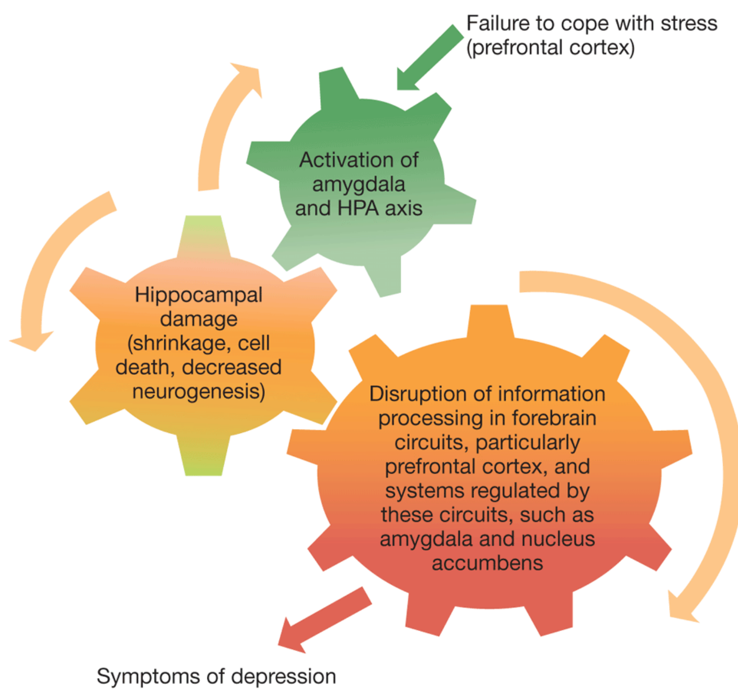
The diathesis-stress model of depression suggests that when people who are genetically prone to developing depression experience life stressors, this nature-nurture interaction will alter the activity of various brain areas. This, in turn, will lead to symptoms of major depression. The challenge for scientists is to identify the brain areas that are involved in these processes.

One brain structure that has received considerable attention is the amygdala. This structure is involved with immediate responses to emotional stimuli (see Module 11.4). The amygdala also stimulates the hypothalamus-pituitary-adrenal (HPA) axis, a system involved with stress responses (see Module 14.2). In all of us—depressed or non-depressed—input from the amygdala leads to an increase in the release of stress hormones such as cortisol. In order to prevent this stress response from getting out of control, the HPA access is *inhibited* by inputs from the hippocampus and frontal lobes (Willner et al., 2013). This balance ensures that the body will release levels of stress hormones that are appropriate to the situation.

In the depressed brain, the amygdala is frequently overactive and overstimulates the HPA axis (see Figure 15.12). As a result, larger amounts of cortisol circulate in the body. This might seem like a minor problem, but cortisol has an additional effect on our emotional responses: it damages cells in the hippocampus (Raison et al., 2006). As a result, this

structure provides less inhibition to the HPA axis (Zunszain et al., 2011), meaning that more stress hormones will be released. This leads to increased anxiety and a negative mood. The long-term effect of this process is that the brain becomes more sensitive to stressful events. So, events that would not have affected stress or mood levels in the past are now able to trigger depressive episodes in the future (Willner et al., 2013).

Figure 15.12 Stress, Depression, and the Brain



The HPA axis is stimulated by the amygdala and inhibited by the hippocampus and prefrontal cortex. If the amygdala is overactive, as sometimes occurs in depression, this will upset the balance and lead to the release of stress hormones. These hormones can damage cells in the hippocampus, which further reduces its ability to inhibit stress responses.

Source: From Willner, P., Scheel-Krüger, J., & Belzung, C. (2013). The neurobiology of depression and antidepressant action. *Neuroscience and Biobehavioral Reviews, 37*, 2331–2371.

Damage to cells in the hippocampus has another sinister effect: it reduces neurogenesis, the growth of new neurons. Scientists have speculated that

neurogenesis in the hippocampus can have an antidepressant effect because it can support new learning and more flexible thinking (Castrén & Rantamäki, 2010). Reducing neurogenesis therefore limits these helpful processes and makes it more difficult for people to avoid the unhealthy cognitions discussed earlier.

There are two additional brain areas that can be dysfunctional in depression. The first is the nucleus accumbens, a brain area related to positive rewards (see Module 5.3). This structure is not as active in individuals with depression (Robinson et al., 2011). This difference may explain why some people with this mental illness experience *anhedonia*, a reduced ability to feel pleasure, and become less interested in activities that they used to love performing. The second brain region that shows altered activity is the medial (middle) part of the prefrontal cortex. Individuals with abnormally high activity in this brain area are more prone to rumination (Cooney et al., 2010). As a result, these individuals will continue to think about negative events, even when it would be better to move on to a different line of thinking.

Given the number of brain areas involved in depression, it is easy to wonder how taking an anti-depressant pill can help. The answer is that these pills influence the levels of specific neurotransmitters—serotonin, dopamine, and norepinephrine—that are involved in depression (Liu et al., 2018). Serotonin appears to be particularly important. People with depression typically have lower serotonin levels in several brain regions, including the amygdala, than non-depressed individuals. Many anti-depressant medications block the reuptake of serotonin, which leaves more serotonin in the synapse available to stimulate the postsynaptic neurons. This process slowly changes the firing rates in the amygdala, hippocampus, and prefrontal cortex so that the depressed individual is less responsive to stress and less likely to ruminate. However, although anti-depressants help reduce the symptoms of depression, the brains of

people who are not depressed but are taking anti-depressants still differ from the brains of people who were not depressed in the first place (Willner et al., 2013). That is one reason why people can still relapse into depression after anti-depressant treatments.

Sociocultural and Environmental Influences on Depression

Listen to the Audio

Given the importance of life stressors in our discussion of depression, it is important to identify sociocultural and environmental factors that are associated with this psychological disorder. For example, the quality of a person's home neighbourhood can be a risk factor for depression (Cutrona et al., 2006). Poor neighbourhoods are associated with higher daily stress levels due to substandard housing and facilities, increased crime rates, and other difficulties. Also, people living in these neighbourhoods are more vulnerable to economic stressors such as unemployment because they generally lack the social connections and the educational and professional opportunities that are available to people living in high-income areas. In addition, environmental influences, such as poverty, can interact with social factors. For example, poor neighbourhoods often have weaker and less supportive social networks in the community. Lower rates of home ownership and higher rates of turnover make it less likely that people will get to know their neighbours; this makes long-lasting social relationships (i.e., potential sources of support) much less common.

Although the effects of the physical and social environment on depression are well-established, less is known about a different environment that almost everyone now inhabits: social media. Recent research suggests, however, that the electronic environment can influence the development and severity of mood disorders like depression.

#Psych

Facebook Depression

Social network sites or *social media* are internet sites that allow users to create profiles and share content with others. Other people, in turn, can comment on this content. Social media sites such as Facebook, Twitter, SnapChat, and Instagram are among the most popular sites on the internet. In fact, in 2017, there were over two *billion* active Facebook accounts (Yoon et al., 2019). Although the ability to electronically interact with others seems like it could help improve our sense of community, everyone reading this knows that social media has a dark side. Recently, psychologists have used the term *Facebook depression* to refer to the fact that people who have a great deal of exposure to social media sites are more likely to develop mood disorders (O'Keeffe & Clarke-Pearson, 2011).

A 2019 review of the research on this topic found some interesting trends. The severity of participants' depressive symptoms increased as the amount of time spent on social media increased (Yoon et al., 2019). Depression was also positively correlated with how frequently people check their social media accounts. These depressive symptoms seem to be related to the tendency to make upward social comparisons when viewing other people's posts. People tend to notice when other people talk about their successes; this can lead to feelings of envy and negative evaluations of the self (Appel et al., 2016).

Of course, it is important to point out that the effects of "Facebook depression" are relatively small. Statistically

speaking, electronic media have a smaller effect on depression than genetics or your family. It is also worth remembering that most people post content on social media that will make themselves look better. Hopefully that thought will make people feel less negative the next time they open up Instagram. Although excessive social media use and depression are associated in some individuals, we cannot conclude that social media exposure *causes* depression or that depression *causes* people to over-use social media. The type of manipulation required to resolve this ambiguity through experimentation is not feasible (or ethical).

Social media sites like Facebook and Instagram can bring people together. But seeing other people's "perfect" lives can also cause individuals to feel more negatively about their own lives.

Roberto Westbrook/Getty Images

Bipolar Disorder

Listen to the Audio

Thus far in this section, we have focused on major depression, the tendency to experience negative moods and cognition. In contrast, **bipolar disorder** (formerly referred to as *manic depression*) is *characterized by extreme highs and lows in mood, motivation, and energy*. It shares many symptoms with major depression—some distinguish the two by referring to major depression as *unipolar depression*—but it occurs only about a third as often (NIMH, 2008). Bipolar disorder involves depression at one end and *mania*—an extremely energized, positive mood—at the other end. Mania can take several forms: talking excessively quickly, racing thoughts, impulsive and spontaneous decisions, or high-risk behaviours. The experience of a manic episode can be exhilarating and parts of it can be highly enjoyable, likely due to the altered activity in brain networks related to reward processing (Phillips & Swartz, 2014). However, the costs of such excessive, indiscriminate, risky behaviour can be very high. During a manic state, individuals feel little concern about the potential consequences of their actions. Later, as they come into a more balanced frame of mind, they may feel a great deal of remorse and embarrassment for their actions, which contributes to their counter-swing into depression.

Bipolar disorder encompasses both ends of an emotional continuum, and individuals with bipolar disorder can move from one end to the other at different rates. Some people with bipolar disorder experience only a few manic episodes in their lives, whereas others go through several episodes

each year. A small number of “rapid cyclers” experience very abrupt mood swings, even within a matter of hours.

Bipolar disorder is relatively difficult to treat because some individuals stop taking their medication when they are in their manic state. Bipolar comes with an additional concern: the increase in energy that occurs when people move from a depressed to a manic phase sometimes allows individuals to act on the negative, self-defeating thoughts that they were experiencing during their depression. Rates of suicide are slightly higher for people with bipolar disorder than for people with major depression (Isometsä, 2014).

Suicide

Listen to the Audio

It is difficult to imagine a worse outcome for a mood disorder than suicide. For people who have not experienced a mood disorder, it is equally difficult to imagine how anyone could reach such a low point. Nonetheless, suicide remains a serious public health concern. It is the second leading cause of death (behind transportation accidents) among Canadian youth (Public Health Agency of Canada, 2013).

There is significant variation in who is most likely to die by suicide. Suicide is four times more likely among males than among females. Many people believe that adolescents are particularly vulnerable to suicide, but the highest suicide rates are actually observed among the elderly: The suicide rate for people 65 and older is nearly 60% higher than the rate for teens (CDC, 2010). Fortunately, research, treatment, and public awareness have significantly reduced the suicide rate among youth since the 1980s (Gould et al., 2003). An unfortunate exception to this trend is in Indigenous communities, where suicide rates remain above the national average.

Suicide often comes as a surprise to the family and friends of the victim, although in some cases clear warning signs are evident (Table 15.4). Among people in their teens and early twenties, the most significant risk factors are mood disorders, recent and extremely stressful life events, a family history of mood disorders (with or without suicide), easy access to a lethal means of suicide (most significantly, firearms), and the presence

of these factors in conjunction with substance abuse (Gould et al., 2003; Moscicki, 2001). Being the victim of bullying and social ostracism is also a risk factor for young people (Klomek et al., 2007).

Certain behavioural signs are often reported by family and friends to have preceded the suicide, giving us behavioural cues to look for in order to identify people at higher risk for dying by suicide. For example, an individual may verbally express despair and hopelessness ("I just want to give up; Nothing matters anymore; They'll be better off when I'm gone"), give away personal possessions, suddenly withdraw from work or school, or have crying spells. For a full description of common behavioural symptoms, consult a proper checklist, or even better, be assessed by a professional. But for now, Table 15.4 lists common warning signs of suicide that are useful to know and watch out for, particularly for people you know who may be at higher risk of dying by suicide.

Table 15.4 Warning Signs of Suicide

Table 15.4 Warning Signs of Suicide

Learn how to recognize the danger signals. Be concerned if someone you know
• Talks about dying by suicide
• Has trouble eating or sleeping
• Exhibits drastic changes in behaviour
• Withdraws from friends or social activities
• Loses interest in school, work, or hobbies
• Prepares for death by writing a will and making final arrangements
• Gives away prized possessions
• Has attempted suicide before
• Takes unnecessary risks
• Has recently experienced serious losses
• Seems preoccupied with death and dying
• Loses interest in their personal appearance
• Increases alcohol or drug use

Source: American Psychological Association. (2011). Suicide warning signs. Retrieved from www.apa.org/topics/suicide/signs.aspx

Recent research has used a novel method of identifying individuals who are thinking about suicide: machine learning. Researchers in the United States created machine-learning codes that allowed a computer to sort through the verbal and non-verbal (voice inflection) characteristics of 379 participants recruited at local hospitals. The algorithm sorted people into three groups—suicidal, mentally ill but not suicidal, and controls (i.e., no psychological disorder present)—with an 85% accuracy rate (Pestian et al., 2017)! Although this is just one study, it does suggest that psychologists and psychiatrists will have additional diagnostic tools at their disposal in the near future.

Of course, the most important factor in saving the lives of individuals who are suicidal is the person's own awareness of their condition. There are many options available for those people who make the decision to seek help.

Psych@

The Suicide Helpline

Suicide hotlines and helplines perform a vital function in today's society and are used by thousands of people every single day. The first telephone suicide helplines were operated by religious organizations and emphasized empathy and active listening. Although this may certainly be a helpful approach, it may not meet the needs of every caller. Modern suicide helplines are staffed by well-trained volunteers with access to suicide prevention specialists who can aid in effectively helping the distressed person, assess the level of risk, and get the

appropriate medical or psychological help. Telephone crisis responders need to flexibly adapt their way of interacting with the caller based on the caller's needs and where they are at that particular moment. For example, first-time callers tend to benefit more from an active listener who will be nonjudgmental, compassionate, and reflective (akin to the practice of establishing rapport with a client, which is so central in psychological counselling). People who are repeat callers need an ever-changing combination of many needs met, including compassion and acceptance, empathy and understanding, and problem-solving strategies and activities (Mishara et al., 2007; Mishara & Daigle, 1997).

Almost all Canadian universities have emergency crisis lines. For people aged 20 and under, the Kids Help Phone is also available at 1-800-668-6868. Additional helpful resources can be found at www.suicidepreventionlifeline.org/ and http://suicideprevention.ca/need-help/.

Module 15.3 Summary

Listen to the Audio

15.3a Know . . . the key terminology related to anxiety, obsessive–compulsive, and depressive disorders.

Review Module 15.3

Start Over Swap

0/12 REVIEWED · 0 MASTERED

diathesis–stress model

Previous Next Got It!

15.3b Understand . . . the different types of anxiety disorders.

Although anxiety disorders share many similarities in symptoms, they differ in terms of what brings about the symptoms and the intensity of the responses. The cues that trigger anxiety vary widely. In generalized

anxiety disorder, just about anything may cause anxiety, whereas in specific phobias, an individual fears only certain objects. Likewise, the frequency and intensity of anxious feelings can range from near-constant worrying to brief periods of highly intense anxiety in phobias and panic disorder.

15.3c Understand . . . how anxiety or depressive disorders can be self-perpetuating.

Both depression and anxiety are characterized by a vicious cycle: With anxiety, anxious or fearful thoughts can lead to physiological arousal; physiological arousal can lead to escape and avoidance to get rid of the immediate fear, which in turn reinforces the anxious thoughts. In depression, a similar pattern can occur with depressed thoughts, self-blame, and social withdrawal.

15.3d Apply . . . your knowledge of anxiety, obsessive–compulsive, and depressive disorders in order to identify which behavioural symptoms are associated with each disorder.

Apply Activity

Match each psychological disorder with its symptom. Select "Check Your Understanding" when you are ready.

Psychological Disorder	Symptom
Bipolar disorder	Karen experienced long bouts of negative moods, but would then experience times when she had immense amounts of energy and felt indestructible.
Generalized anxiety disorder	Pierre felt like he was always nervous and panicking, even when there was no clear reason why he should feel that way.
Major depression	Luke felt like he had no energy. He also tended to think about things that had gone wrong during his day and had trouble shifting his thoughts to a different topic.
Obsessive-compulsive disorder	Pablo was frequently concerned that he would forget to turn off his stove. As a result, he checked the stove exactly seven times each morning before he left for class.
Specific phobia	Shaneequa was so afraid of driving that she ended up moving so that she was within walking distance of her work.

Check Your Understanding

15.3e Analyze . . . whether maladaptive aspects of specific phobias might arise from perfectly normal, healthy behaviours.

To analyze this issue, we need to examine the specific symptoms that occur in someone who has a phobia and is showing an adaptive response (fear, anxiety) but to an inappropriate stimulus or situation. It is perfectly reasonable and healthy to be cautious about heights, for example, in the sense that falls can be dangerous, even life-threatening. This reaction is maladaptive only when the fear response is so intense or out of context that it interferes with daily life. Imagine a house painter who cannot climb a ladder or scaffold. Unless they overcome their fear (or finds very short houses to work on), they will have to make major adjustments to accommodate the fear.

Module 15.4 Schizophrenia

Listen to the Audio

Robert P. Matthews/Princeton University/Getty Images

Learning Objectives

15.4a Know . . . the key terminology associated with schizophrenia.

15.4b Understand . . . how different neurotransmitters affect individuals with schizophrenia.

15.4c Understand . . . the genetic and environmental contributions to schizophrenia.

15.4d Apply . . . your knowledge to identify key features of schizophrenia.

15.4e Analyze . . . claims that schizophrenia is related to genius or violent behaviour.

John Nash's story is a remarkable one in many ways. Nash is remarkable for being the inspiration for a movie, A Beautiful Mind. *He is remarkable for being a genius, a mathematician, and winner of a Nobel Prize for his work on game theory (Google "Nash equilibrium"), which has become a cornerstone of modern economics and has immense importance in understanding society. He is also remarkable for being an underachiever, you might say, in the sense that Nash undoubtedly did not rise to his full potential, or anything close to it. The world was, at least partially, deprived of one of its most brilliant minds because Nash also had the remarkable characteristic of having schizophrenia.*

In 1959, while a professor at MIT, and with his wife expecting their first child, Nash began to experience delusional patterns of thought, developed strange and rigid beliefs, and felt that he was playing some sort of special role as a messenger of some kind, hearing and seeing things that weren't there, even thinking he was being contacted by aliens who were leaving messages for him in newspapers. His ability to function in daily life fluctuated greatly as he veered between his lucid, brilliant mind and his confused, schizophrenic mind. His marriage ended shortly thereafter, and Nash spent almost a decade in a

psychiatric institution. The voices in his head continued to haunt him for decades. Eventually, he learned how to manage his symptoms and function again in the world. He was able to return to work and even remarried his wife (in 2001). He remained an active mathematician and frequent speaker until his death in 2015, when he and his wife were both killed in a tragic car crash.

John Nash's case raises some central questions about schizophrenia. What are the underlying neurological and cognitive processes that are affected by the disorder and that produce the symptoms of a person's experiences? Are there ways of gaining control over symptoms, possibly by strengthening the underlying systems? What factors contribute to better management of schizophrenic symptoms and to slowing or halting its long-term progression?

Nash's story also challenges some common assumptions about schizophrenia, such as the belief that people with schizophrenia are to be feared because they are perpetually unstable and likely to do random, unpredictable, even violent or dangerous things. Nash himself managed to live a productive, quiet, peaceful, and generally happy life. Although this isn't always the case with schizophrenia, it is encouraging to know that such happy endings are possible.

Schizophrenia is often regarded as one of the more devastating psychological illnesses, and indeed, severe cases of schizophrenia involve a shocking loss of basic functioning. Although schizophrenia is not common (affecting only between approximately four to eight out of every 1000 adults worldwide [Bhugra, 2005; Saha et al., 2005]), it seems to be universal, appearing in cultures all over the world and across history. Historically, schizophrenia was viewed as an incurable form of dementia that developed in the teens or early 20s. This is likely why it was referred to as *dementia praecox* (alternatively translated as "premature dementia" or "precocious madness") by Emil Kraepelin in his influential textbooks in

the 1890s. It wasn't until the 1950s that researchers began to understand the neural systems involved in this disorder. Thanks to decades of intensive research, we now know that schizophrenia is a complex illness caused by a number of genetic, biological, and social factors.

Symptoms and Types of Schizophrenia

Listen to the Audio

There are many popular but misguided beliefs regarding schizophrenia. For example, people believe that individuals with schizophrenia have more than one personality. This is an unfortunate side effect of the name *schizophrenia*, which implies a splitting of consciousness. Although this term, which was coined by Paul Eugen Bleuler in 1908, originally meant a split between emotion and different thought processes, it was often misinterpreted by the public to imply split personalities (Peralta & Cuesta, 2011). However, the presence of multiple personalities is a completely different disorder known as Dissociative Identity Disorder (DID; see Module 15.2).

Schizophrenia is now defined as *a brain disease that causes the person to experience significant breaks from reality, a lack of integration of thoughts and emotions, and problems with attention and memory*. Symptoms may begin to occur and escalate very gradually, remaining largely unnoticeable for a long time before family members start to perceive a pattern. In other cases, however, symptoms can begin and escalate very rapidly. There is, therefore, a very wide range of possible trajectories that the disease may follow over time. Every case of schizophrenia is its own journey.

Stages of Schizophrenia

Listen to the Audio

In most cases of schizophrenia, there are three distinct phases: prodromal, active, and residual. These tend to occur in sequence, although individuals may cycle through all three many times. In the **prodromal phase**, *people may become easily confused and have difficulty organizing their thoughts, they may lose interest and begin to withdraw from friends and family, and they may lose their normal motivations, withdraw from life, and spend increasing amounts of time alone, often deeply engrossed in their own thoughts*. It is not uncommon for other people to get upset as a result of these behaviours, assuming the person is lazy or otherwise being irresponsible. In the **active phase**, *people typically experience delusional thoughts, hallucinations, or disorganized patterns of thoughts, emotions, and behaviour*. This phase usually transitions into the **residual phase**, *in which people's predominant symptoms have disappeared or lessened considerably, and they may simply be withdrawn, have trouble concentrating, and generally lack motivation*.

There is huge variety in terms of the progression of schizophrenia. Some people cycle through the three stages only a couple of times in their lives, whereas others may cycle repeatedly. Typically, the severity of the withdrawal in the residual phase tends to increase with repeated episodes, and their ability to function normally seems to decrease.

The symptoms of schizophrenia are most pronounced in the active phase of the disease, but you must always remember that the transitions

between these phases will not be perfectly clean. There may be times when symptoms do not occur during the active phase. There may also be times when they do occur during the residual phase. Additionally, the person with schizophrenia may experience short-term resurgences of symptoms, often triggered by stressful periods or episodes in their lives.

Symptoms of Schizophrenia

Listen to the Audio

Schizophrenia is associated with a number of symptoms. A key distinction is made between positive and negative symptoms (Harvey & Walker, 1987). **Positive symptoms** refer to *the presence of maladaptive behaviours, such as confused and paranoid thinking, and inappropriate emotional reactions*. In contrast, **negative symptoms** involve *the absence of adaptive behaviour, such as absent or flat emotional reactions, lack of interacting with others in a social setting, and lack of motivation*.

One common positive symptom is the presence of **hallucinations**, *alterations in perception, such that a person hears, sees, smells, feels, or tastes something that does not actually exist, except in that person's own mind*. These experiences are often accompanied by **delusions**, *beliefs that are not based on or well integrated with reality*. For example, people may believe that they are someone famous, or that they have a divine purpose. They may believe there is special significance or hidden messages or codes in the media that they encounter. They might believe that everybody despises them, or that they are being constantly followed and that their life is in danger. Or they might believe they can control the wind or communicate telepathically with birds. Many of these symptoms are examples of *delusions of grandeur*, a belief that an individual is more important or talented than they really are. For example, consider the following personal account of Kurt Snyder, who wrote a book about his experiences with schizophrenia during college:

> I thought about fractals and infinity for many years. I always told myself I was on the verge of discovery, but I simply had to think a little bit harder about it. I just wasn't thinking hard enough. The reality is that the problems I was trying to solve were far beyond my mental abilities, but I didn't recognize this fact. Even though I had no evidence to substantiate my self-image, I knew in my heart that I was just like Einstein, and that someday I would get a flash of inspiration. I didn't recognize the truth—that I am not a genius. I kept most of my mathematical ideas to myself and spoke to very few people about them. I was paranoid that someone else would solve the riddle first if I provided the right clues. (Snyder, 2006, p. 209)
>
> Source: Snyder, K. (2006). Kurt Snyder's personal experience with schizophrenia. *Schizophrenia Bulletin, 32* (2), 209–211.

Kurt Snyder began experiencing schizophrenia in college. *Me, Myself, and Them* is his personal account of living with schizophrenia.

Provided by Kurt Snyder, author

In addition to hallucinations and delusions, individuals with schizophrenia often have **disorganized behaviour**; this term describes *the considerable difficulty people with schizophrenia may have completing the tasks of everyday life*—cooking, taking care of their hygiene, socializing. They have great difficulty organizing their behaviour enough to complete tasks before getting distracted by other thoughts or things to do. This makes it difficult to follow a project, or even a train of thought, to completion, as their minds may jump from thought to thought uncontrollably.

The negative symptoms of schizophrenia can make it difficult to form and maintain social connections. These individuals typically have difficulty reasoning about social situations and show relatively poor social adjustment (Done et al., 1994). In addition, their emotional expressions and ability to react to the emotions of others may be impaired (Penn & Combs, 2000). For example, people with schizophrenia may maintain a neutral mask-like expression on their faces and show little response to smiles or other expressions from people around them. As a result, the person with schizophrenia generally is not as socially competent and strikes others as a little "odd"; this can set social feedback processes in motion (such as others then avoiding eye contact or extended social interactions with the schizophrenic person). This, in turn, may cause the person with schizophrenia to become aware of this negative social feedback, to feel self-conscious and uncomfortable, and to be more likely to socially withdraw in the future.

Another type of negative symptom of schizophrenia is *catatonia*, a movement disorder in which an individual does not move and rigidly remains in a pose for a lengthy period of time. The patient is often unresponsive to doctors, family, or other patients during these catatonic states. The fact that the initiation of movement—which involves the neurotransmitter dopamine—is sometimes a feature of schizophrenia

suggested to researchers that this brain chemical is likely involved in this psychological disorder.

Individuals with schizophrenia experience several additional problems with cognitive functioning. These range from basic, low-level physiological responses, such as excessive eye blinking in response to stimulation (Perry et al., 2002), to more complex cognitive skills, such as those required for standardized achievement tests—test scores tend to drop during adolescence as the disorder begins and progresses (Fuller et al., 2002). Schizophrenia can also involve deficits in working memory that connect to symptoms associated with schizophrenia, such as the inability to keep track of a train of thought, organize the sequence of a conversation, and handle multiple tasks at once. Working memory deficits may partially explain the disorganized thoughts and speech characteristic of schizophrenia (Park et al., 1999).

Common Subtypes of Schizophrenia

Listen to the Audio

As you can see, numerous symptoms accompany schizophrenia. For some individuals, the symptoms cluster into different patterns, leading mental health professionals in the past to identify subtypes of the disorder. These subtypes were dropped from official practice in the DSM-5 (released in 2013), as they are artificial categorizations of complex behaviour patterns, and are often not reliably measurable. But these terms are still commonly used and are therefore worth being aware of:

- **Paranoid schizophrenia**: *Symptoms include delusional beliefs that one is being followed, watched, or persecuted, and may also include delusions of grandeur or the belief that one has some secret, insight, power, or some other characteristic that makes one particularly special.*
- **Disorganized schizophrenia**: *Symptoms include thoughts, speech, behaviours, and emotions that are poorly integrated and incoherent. People with disorganized schizophrenia may also show inappropriate, unpredictable mannerisms.*
- **Catatonic schizophrenia**: *Symptoms include episodes in which a person remains mute and immobile—sometimes in bizarre positions—for extended periods. Individuals may also exhibit repetitive, purposeless movements.*

People who experience catatonic schizophrenia will remain immobile, even if in a bizarre position, for extended periods of time.

Grunnitus Studio/Photo Researchers, Inc./Science Source

These terms are also frequently used in popular culture when discussing schizophrenia. However, as you will read, movies and the media don’t always portray schizophrenia accurately.

Watch Living with a Disorder

Myths in Mind

Schizophrenia Is Not a Sign of Violence or of Being a "Mad Genius"

Although schizophrenia is a widely recognized term, it is also widely misunderstood. As was mentioned in the opening story about John Nash, people may believe that schizophrenia makes people violent or dangerous, or causes people to have different personalities. People also commonly believe that the "madness" of schizophrenia is associated with being a genius. It can be difficult to dispel such myths, especially with high-profile cases that fit so well with these common beliefs; cases like John Nash or Ted Kaczynski (aka the "Unabomber").

Similar to Nash, Kaczynski was a very bright mathematician who seemed to slip into schizophrenic delusions. In contrast to Nash, however, Kaczynski's delusions led him to take violent actions against what he perceived to be the evil system of our society. This earned him his Unabomber nickname, because he sent bombs through the mail to prominent researchers at various universities.

The truth is that schizophrenia is not associated with genius but, in fact, with cognitive deficits. In contrast to Ted Kaczynski and John Nash, most people with schizophrenia score slightly below average on IQ tests (Woodberry et al., 2008). Also, people

with schizophrenia are only rarely violent. In these cases, other factors such as substance abuse usually play a big role. People with schizophrenia do not have a propensity for violence that is meaningfully different from the rest of the population (Douglas et al., 2009; Fazel et al., 2009), and are likely to isolate themselves and end up in situations in which they are likely to be harmed. In fact, it's the people with schizophrenia who should perhaps fear the rest of society. People with mental illnesses are approximately 10 times more likely to be victims of crime than the rest of the population (Teplin et al., 2005).

Mug Shot/Alamy Stock Photo

Movies and the media often portray people with schizophrenia as either violent or as unstable geniuses, such as Ted Kaczynski (the "Unabomber"). In reality, people with schizophrenia are more likely to be victims than aggressors in our society.

Movies and the media often portray people with schizophrenia as either violent or as unstable geniuses, such as Ted Kaczynski (the "Unabomber"). In reality, people with schizophrenia are more likely to be victims than aggressors in our society.

Mug Shot/Alamy Stock Photo

Explaining Schizophrenia

Listen to the Audio

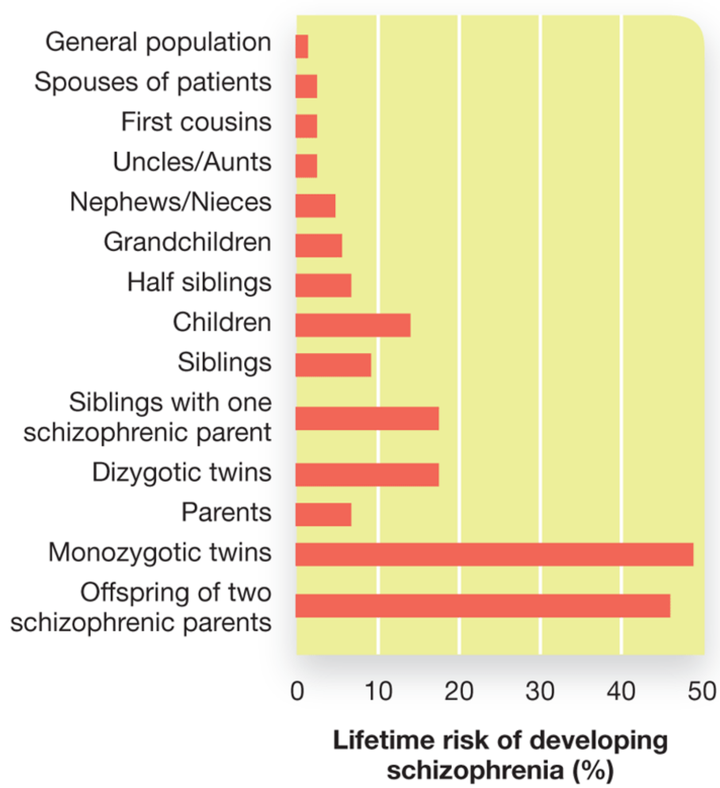
So far, we have described schizophrenia based on its psychological and physical characteristics. Researchers are also very curious about the underlying sources of these characteristics and have employed a wide range of techniques to discover what causes schizophrenia. Through the application of the biopsychosocial model, a holistic understanding of schizophrenia is emerging.

Genetics

Listen to the Audio

Studies using twin, adoption, and family history methods have shown that as genetic relatedness increases, the chance that a relative of a person with schizophrenia will also develop the disorder increases (see Figure 15.13). For example, if one identical twin has schizophrenia, the other twin has a 25% to 50% chance of developing it. This rate is significantly higher than the 10% to 17% rate found in dizygotic (fraternal) twin pairs (Gottesman, 1991).

Figure 15.13 Genetic Influences for Schizophrenia



The more genetic similarity an individual has to a person with schizophrenia, the more likely that he or she will also develop the disorder.

For decades, behavioural genetic scientists have known that genes contribute to schizophrenia, but they have not identified the specific genes that are involved. Data from the Human Genome Project have provided researchers with a powerful tool in their search for the genes linked with schizophrenia. A recent study of 37 000 people with schizophrenia and 113 000 control participants identified 108 genes that are associated with this disorder (Ripke et al., 2013)! However, this study also noted something very interesting: a number of these genes were also associated with other psychological disorders, suggesting that some genes are related to neurodevelopmental impairments *in general* while others may be related to specific disorders (Owen & O'Donovan, 2017). Although scientists are making incredible advances in their quest to understand the genetics of schizophrenia, much more research is needed before we will know which combinations of genes are associated with the various symptoms of this psychological disorder.

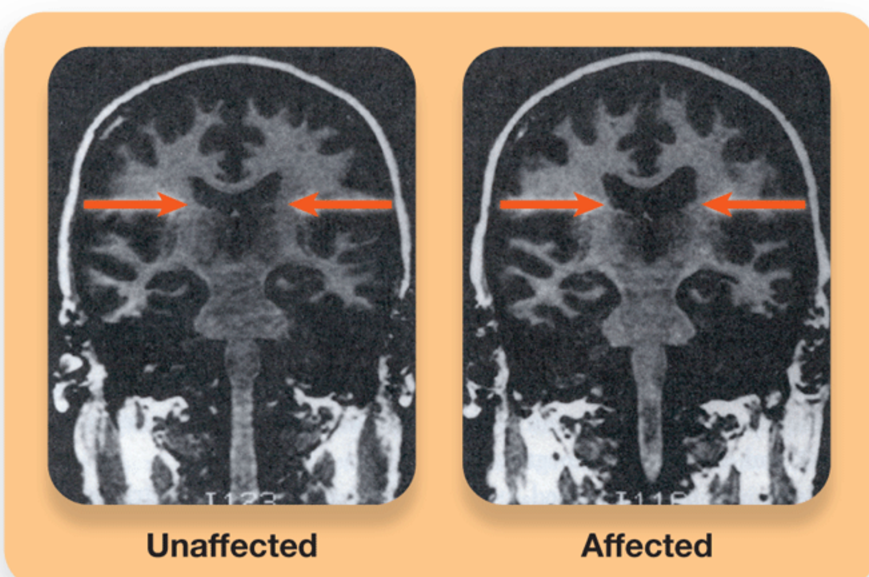
Schizophrenia and the Nervous System

Listen to the Audio

One important neurological characteristic of people with schizophrenia is the size of the brain's ventricles (the fluid-filled spaces in the core of the brain). People with schizophrenia have ventricles that are 20% to 30% larger than people without schizophrenia (see Figure 15.14; Murray et al., 2017). The reason for these larger ventricles is a loss of brain matter, particularly in limbic system structures such as the amygdala and hippocampus (Grace, 2016; Wright et al., 2000). This thinning of brain structures can amount to a 2% reduction of total brain volume.

Figure 15.14

Brain Volume in One Monozygotic Twin with Schizophrenia and Another without Schizophrenia



The brains of two genetically identical individuals, one affected with schizophrenia and the other unaffected, are shown here. The arrows point to the spaces created by the ventricles of the brain. Note the significant loss of brain matter in the affected individual.

Courtesy of E. Fuller Torrey and Daniel Weinberger

The brains of people with schizophrenia are not just different in size; they also *function* differently. People with schizophrenia show lower levels of activity in their frontal lobes, both in resting states and when engaged in cognitive tasks, suggesting that these brain regions are not functioning at an optimal level (Hill et al., 2004). This lower frontal lobe activity likely explains why individuals with schizophrenia have problems controlling their attention and putting information into a logical narrative (Fan et al., 2018).

Changes in brain *chemistry* are also evident in schizophrenia. People with schizophrenia have an increased rate of firing in dopamine-releasing cells. Some of this over-activity is in a part of the brain known as the basal ganglia, which is involved in a number of functions including reward responses. As a result of this firing, stimuli that should be meaningless are interpreted as being quite noteworthy (Heinz & Schlagenhauf, 2010). Excess firing of these dopaminergic cells can produce the types of positive symptoms associated with schizophrenia, such as hallucinations and delusions. However, dopamine cannot be the whole neurochemical story, as it is unrelated to negative symptoms such as flattened emotion and lack of speech (Andreasen et al., 1995).

Glutamate, another neurotransmitter, appears to be underactive in certain brain regions, including the hippocampus and the frontal cortex. Glutamate is the brain's primary excitatory neurotransmitter, so a reduction of glutamate in those areas would correspond to a reduction of their functioning. Improper functioning of glutamate systems in the brain

is a likely cause of negative symptoms in schizophrenia (Uno & Coyle, 2019). Interestingly, glutamate receptor activity is also inhibited by the drug PCP (angel dust), which in high doses can cause symptoms that mirror those of schizophrenia.

Psychologists have long noted that individuals who are being treated with antipsychotic drugs that block dopamine tend to be heavy smokers. One possible reason is that nicotine helps to stimulate the release of additional dopamine. As a result, heavy nicotine use stimulates the dopamine-rich reward and cognitive centres of the brain (Winterer, 2010).

ImageBroker/Alamy Stock Photo

The fact that schizophrenia has been linked with differences in genes, neurotransmitters, and the volume of brain structures suggests that the mechanisms underlying this disorder are not simple. Indeed, as you will read in the next section, one of the best-known hypotheses about the cause of schizophrenia suggests that it involves an interaction between an external agent (possibly a virus) and the brain at some of its earliest stages of development.

Working the Scientific Literacy Model

The Neurodevelopmental Hypothesis

Listen to the Audio

Schizophrenia is obviously a complex disorder, and no single explanation has been able to account for all the variations in its symptoms, severity, and duration. One of the leading perspectives on the causes of schizophrenia approaches the disorder from a biopsychosocial perspective, emphasizing the interaction between factors at different levels of analysis.

What do we know about the neurodevelopmental hypothesis?

People who develop schizophrenia often exhibit identifiably abnormal patterns of behaviour early on. Indeed, the **neurodevelopmental hypothesis** suggests that *the adult manifestation of what we call "schizophrenia" is the outgrowth of disrupted neurological development early in the person's life*. In fact, schizophrenia may even be set in motion by environmental factors while the person is still in the womb, such as exposure to flu viruses.

One intriguing research finding is that people with schizophrenia are more likely to have been born during winter months (Tochigi et al., 2004). One hypothesis for this trend is that winter births carry this higher risk because the onset of the flu season, in the fall, coincides with the latter part of the first trimester, in which

the fetus's brain is developing at an enormous rate. Maternal exposure to the influenza virus at such a critical time of neurological development is argued to be one contributing factor to schizophrenia. More generally, environmental factors that cause stress for the mother while pregnant, such as losing her spouse or experiencing trauma such as war or violence, can impact fetal development. The massive release of stress hormones during such difficult events has a variety of neurological and cognitive effects on the developing fetus, which could increase the risk of developing schizophrenia (Brown & Derkits, 2010; King et al., 2010).

How can science test the neurodevelopmental hypothesis?

The neurodevelopmental hypothesis draws from research on genetic and prenatal factors. However, the developmental emphasis of the hypothesis gains strength from behavioural evidence collected during childhood and adolescence, which shows that people who develop schizophrenia showed warning signs when they were very young. For example, when psychologists viewed home movies of infants and children who subsequently developed schizophrenia, they noted that these children showed some unusual motor (i.e., movement) patterns, primarily on the left side of the body, such as jerky, repeated, and unnecessary arm movements (Walker et al., 1994). These motor patterns were not present in their siblings, who did not have schizophrenia. This evidence suggests that a precursor of schizophrenia is present very early in life, setting in motion the processes and shaping the patterns of brain activity that lead further into the development of the disorder.

In adolescence, psychologists can detect the *schizophrenia prodrome*, a collection of characteristics that resemble mild forms

of schizophrenic symptoms. For example, a teenager might become increasingly socially withdrawn and have some difficulty with depression and anxiety. But the most telling problems include experiences that resemble somewhat mild hallucinations and delusions. As one example, a teen might say, "I seem to keep hearing my mother calling my name before I fall asleep, even when I know she isn't home. It is strange . . ." (Walker et al., 2010, p. 206).

Can we critically evaluate this information?

An obvious question that arises from the previous section is why are these two specific periods of development—the first trimester of gestation (pregnancy) and adolescence—linked with development of schizophrenia? What makes these two periods special? It turns out that both of these periods are associated with growth spurts for the prefrontal cortex, the regions of the frontal lobe involved with higher cognitive functions such as decision making, attentional control, and problem solving (Selemon & Zecevic, 2015). During the first trimester of fetal development, the fetal brain grows at an astonishing rate as new cells are born and different sections of the brain, such as the brainstem and midbrain, begin to develop. By the eighth week of development, the group of neurons that will eventually be the prefrontal cortex have developed. Animal-based research has shown that maternal infections during the first trimester lead to smaller cortical surface areas in this region (Stolp et al., 2011).

During adolescence, the frontal lobes go through another important change. In addition to growing in volume, the frontal lobes also *lose* a large number of synapses. This might seem strange at first, but this *pruning* removes rarely used synapses so that neural resources can be directed to the more frequently used ones. In other words, your brain becomes more efficient. In

adolescents who will develop schizophrenia, too much synaptic pruning occurs. Thus, they have fewer connections between neurons, which leads to a smaller and less powerful prefrontal cortex (Selemon et al., 1995).

Why is this relevant?

By identifying prenatal risk factors and developmental patterns related to schizophrenia, it may be possible to alter the progression of the disorder. As part of this process, researchers will need to improve our understanding of the types of emotional support pregnant women need in order to reduce the effects of stress hormones on the fetus. A long-term goal of these related research programs would be to prevent schizophrenia from developing, or at least to control its severity (McGlashan et al., 2006; McGorry et al., 2002). To accomplish these goals, researchers will have to rely on all levels of explanation: genetics, prenatal influences, brain structure and function, and psychosocial factors.

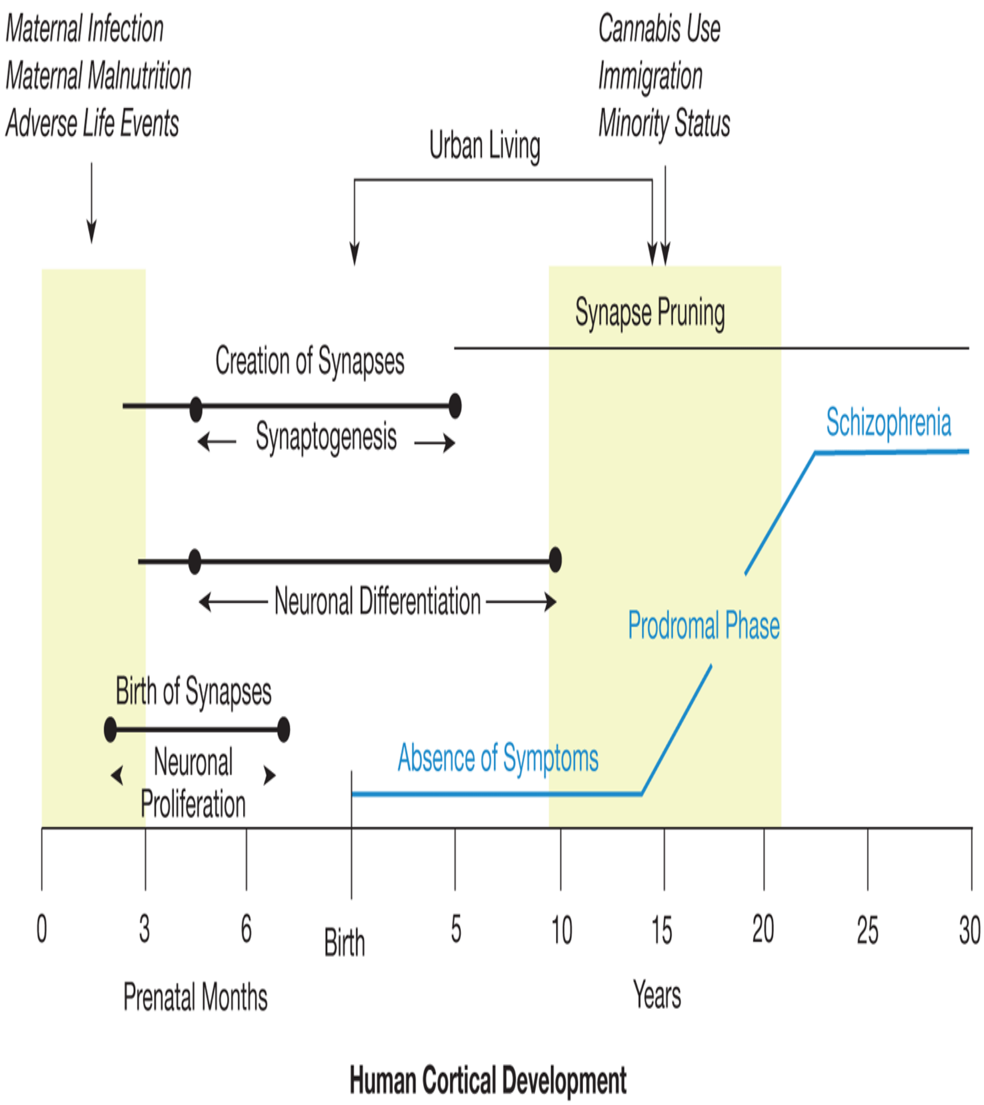
Thus far, you have read about genetic and neural explanations for schizophrenia. These factors obviously interact, with genes influencing how and when different brain areas will develop. But genes can't explain everything—at least not on their own. Think back to the twin studies: if one identical twin has schizophrenia, the likelihood of the other identical twin also having this disorder is 25% to 50%. So, although genetics can explain some causes of schizophrenia, there must be social and environmental factors that explain the remaining 50% to 75% of the variability. Although researchers have not identified all of the potential factors influencing the development of schizophrenia, there are several that are worth discussing.

Environmental and Social Influences on Schizophrenia

Listen to the Audio

The period of fetal development and birth contains a number of potential triggers for schizophrenia (see Figure 15.15). In addition to the risk that maternal infections and viruses discussed above, there are a number of other factors that can make schizophrenia more likely. Studies of populations that were experiencing famines found that if a mother experienced malnutrition during pregnancy, there was an increased likelihood of the child developing schizophrenia (Susser et al., 1996). Additionally, difficult births in which the umbilical cord limits oxygen to the baby were also linked to the later development of this disorder (Cannon et al., 2002).

Figure 15.15 Social and Environment Factors Influencing the Development of Schizophrenia



Schizophrenia is caused by genes interacting with a number of different social and environmental factors. Some of these factors influence the development of the fetal brain, particularly during the first trimester of development. Other factors can influence the very sensitive period of adolescence, when synaptic pruning in the prefrontal cortex leads to the development of the efficient adult brain.

Adapted from Figure 5 from Selemon & Zecevic (2015). Page 7.

Childhood is also associated with a number of risk factors. Head injuries occurring prior to age 10 also put people who are genetically vulnerable to schizophrenia at greater risk for developing the disorder (AbdelMalik

et al., 2003). Also, being raised in an environment where psychosocial stressors (e.g., interpersonal conflict, social isolation, poverty) are more abundant, such as modern urban environments, puts individuals at greater risk for developing schizophrenia (Henssler et al., 2019), because schizophrenic episodes are often triggered by acutely stressful circumstances. Neuroscientists suggest that the frequent feelings of social defeat that occur in stressful urban environments—particularly for immigrant and minority groups—changes the sensitivity of the basal ganglia's reward system. This results in altered dopamine release, one of the key features of schizophrenia (Selten et al., 2013).

Closely related to the impact of stress on the development of schizophrenia is the role of social support. Research has shown that the progression of schizophrenia is strongly related to the way in which family members support and treat the person with schizophrenia. Families high in *emotional expressiveness* (EE) tend to be overly critical and controlling, whereas families low in EE tend to be more supportive, accepting, and non-judging (O'Driscoll et al., 2019). As several teams of researchers have found, there are large differences between people with schizophrenia who live in high-EE versus low-EE families. People with schizophrenia are three to four times more likely to experience a relapse of their symptoms within a nine-month period if they live in high-EE families (Brown et al., 1972; King & Dixon, 1999). This trend has led to the creation of therapeutic interventions designed to help families reduce their negative behaviours and to learn to be more supportive.

The final environmental factor that we will discuss is marijuana. Some research suggests that a small proportion of people who use marijuana develop psychotic symptoms, possibly because the drug interacts with the genes involved in schizophrenia (Caspi et al., 2005). Indeed, most researchers now agree that frequently smoking marijuana increases the likelihood of developing schizophrenia, particularly if the marijuana is of

a potent, synthetic variety (Marconi et al., 2016). But this doesn’t mean that anyone who lights up is going to develop schizophrenia. Rather it means that *if someone is has genes that make them more likely to develop schizophrenia*, then smoking marijuana—or experiencing a difficult birth or psychosocial stressors or a head injury—will make it more likely that these genes will be expressed. Thus, schizophrenia is an interaction between genes and the environment—nature and nurture.

Culture and Schizophrenia

Listen to the Audio

In Module 15.1, we introduced the topic of cultural perceptions of mental illness. Differing cultural perspectives are strongly evident when it comes to schizophrenia. For example, ethnicity influences the types of experiences that individuals report having. A U.S.-based study found that Anglo-Americans tend to focus on the mental experiences of the disorder, such as disorganized thinking and emotions. In contrast, Mexican Americans focus more on how schizophrenia affects the body, such as by producing tension or tiredness. They conceive of the disorder as any other form of illness, rather than viewing mental disorders as a separate type of condition (Weisman et al., 2000).

Beliefs about mental illness are linked to varying cultural views of the world (McGruder, 2004). Many people throughout the world, such as the Swahili of Tanzania, believe that what we call schizophrenia is really a sign that spirits have invaded or are communicating with the body. In some cultures, it is thought that the person is being gifted with the ability to communicate in some fashion with the spirit world. These individuals are given important status in the community—virtually the opposite to the treatment of schizophrenia in Western culture.

As you think about the different ways that a person with schizophrenia would be treated in these different cultural contexts, and the presumed sophistication of our scientific understanding of what we call schizophrenia, consider one surprising fact—the long-term outcomes for

people who have symptoms that would be diagnosed as schizophrenia are actually *better* in developing countries and traditional cultures that have been minimally influenced by the Western medical system (Harrison et al., 2001). This shows us that regardless of the symptoms of a disorder, people benefit from being treated with kindness and compassion.

Module 15.4 Summary

Listen to the Audio

15.4a Know . . . the key terminology associated with schizophrenia.

Review Module 15.4

Start Over Swap

0/13 REVIEWED · 0 MASTERED

neurodevelopmental hypothesis

Previous Next Got It!

15.4b Understand . . . how different neurotransmitters affect individuals with schizophrenia.

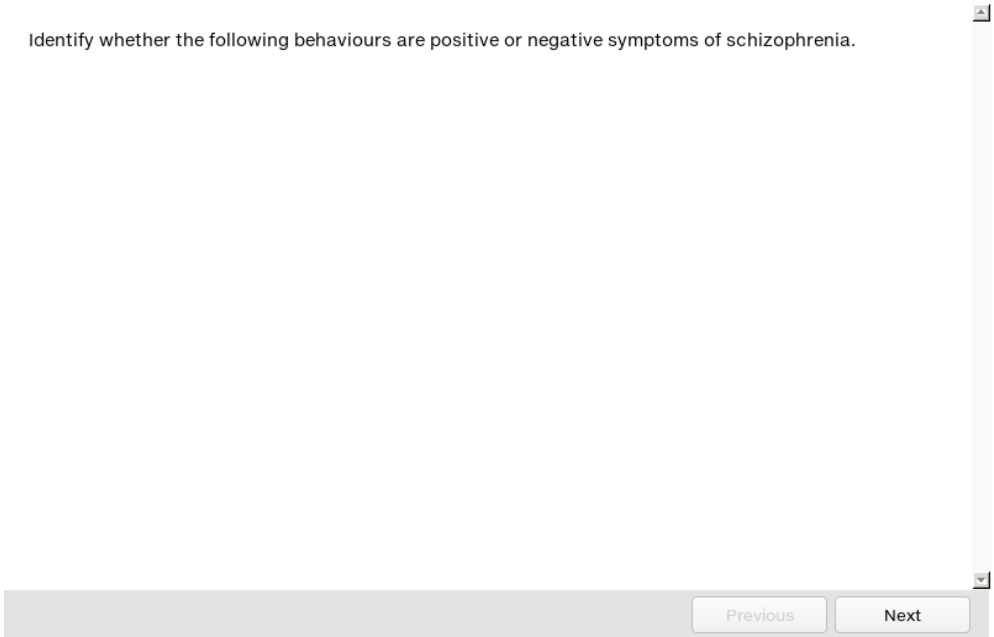
Part of how we can explain schizophrenia is by identifying the neurotransmitters that are affected by this disorder. Increased dopamine levels are associated with the positive symptoms of schizophrenia, such as having hallucinations or delusions. Reduced levels of glutamate, an excitatory neurotransmitter, have been linked with the negative symptoms of schizophrenia, such as flat emotional reactions and a lack of motivation.

15.4c Understand . . . the genetic and environmental contributions to schizophrenia.

The neurodevelopmental hypothesis claims that at least some neurological abnormalities are present at birth, although it does not state to what degree these abnormalities are genetic or environmental. Nevertheless, some research suggests that prenatal exposure to the flu or to significant amounts of stress hormones are risk factors for this type of mental illness. Genetics seem to play a role, as twin studies show that if one identical twin has schizophrenia, the other has a 50% chance of developing the disorder—a substantial increase over the 1% occurrence rate in the general population.

15.4d Apply . . . your knowledge to identify key features of schizophrenia.

Apply Activity



15.4e Analyze . . . claims that schizophrenia is related to genius or violent behaviour.

As you have read, some high-profile cases highlight people with schizophrenia who are intellectually brilliant. In reality, however, research tells us that the average intelligence of people with schizophrenia is similar to, although slightly lower than, the norm. Similarly, the belief that schizophrenia leads to violence derives from a small group of high-profile examples. In truth, there does not seem to be an increased risk of violence associated with schizophrenia alone.

Chapter 16
Therapies

Listen to the Audio

16.1 Treating Psychological Disorders

Mental Health Providers and Settings

Evaluating Treatments

Working the Scientific Literacy Model: Can Self-Help Treatments Be Effective?

Barriers to Psychological Treatment

Module 16.1 Summary

16.2 Psychological Therapies

Insight Therapies

Behavioural, Cognitive, and Group Therapies

Working the Scientific Literacy Model: Virtual Reality Therapies

Module 16.2 Summary

16.3 Biomedical Therapies

Drug Treatments

Working the Scientific Literacy Model: Is MDMA an Effective Treatment for Posttraumatic Stress Disorder (PTSD)?

Technological and Surgical Methods

Module 16.3 Summary

Module 16.1 Treating Psychological Disorders

Listen to the Audio

Ambrophoto/Alamy Stock Photo

Learning Objectives

16.1a Know . . . the key terminology associated with mental health treatment.

16.1b Understand . . . the major barriers to seeking help for psychological disorders.

16.1c Understand . . . the arguments for and against involuntary treatment.

16.1d Apply . . . your knowledge to suggest what approach to therapy is likely most appropriate for a given situation.

16.1e Analyze . . . whether self-help options, such as popular books, are a useful therapy option.

"The Power of Vulnerability" has become one of the most popular TED talks ever given. This simple, from-the-heart talk involves a brilliant, personable, and completely vulnerable woman talking about how she went to a therapist because she felt like she was having a breakdown. Brené Brown's talk courageously exposed her personal struggle with feelings of shame and "not being good enough" to millions of TED viewers. Her deeply moving story is one that many people can relate to. Brown's crucial message was that it is normal and indeed healthy for a person to go to a therapist to deal with issues like these. By being so open about her experiences, she sets an example for the rest of us that a key step toward overcoming the stigma surrounding mental illness and therapy is to talk about it.

Western culture's strong individualistic emphasis and do-it-yourself mentality fosters the attitude that people need to be independent and "strong." Mental illness is often seen as a sign of weakness, and negative stigma surrounds therapists who are sometimes stereotyped as "quacks" or "shrinks," lost in psycho-babble and out of touch with reality.

It is therefore worth paying attention when public events like Brown's TED talk, or public awareness campaigns like Bell's "Let's Talk," show the public that therapy is a part of many people's lives. Perhaps the stigma associated with mental illness and therapy is finally starting to dissipate.

In Chapter 15, we described some of the psychological disorders that can affect people. Disorders touch many people's lives, either directly (i.e., the individuals themselves) or indirectly via friends, family, neighbours, or coworkers. Clearly, there is a need for effective psychological treatments. In fact, each year in Canada, approximately 10% of the population seeks some form of treatment for mental health issues (Lesage et al., 2006).Importantly, not all treatments are the same. As you will read in the first part of this module, there are several types of mental health providers, each with a specific type of training.

Mental Health Providers and Settings

Listen to the Audio

A wide variety of treatment settings are available for people in need of mental health care. The type of treatment people receive depends on several factors, including their age, the type and severity of the disorder, and the existence of any legal issues and concerns that coincide with the need for treatment. Mental health services include inpatient care, outpatient office visits, the use of prescription drugs, attending therapy sessions, and taking part in support groups. Different types of care tend to be delivered by professionals with different training and skill sets.

Mental Health Providers

Listen to the Audio

In popular culture, the terms *psychologist* and *psychiatrist* are often (and incorrectly) used as if they mean the same thing. In fact, there are some major differences between the two, and even within each category there can be huge differences in how treatments are provided.

Clinical psychologists are perhaps the best-known type of psychologist in the mental health field. **Clinical psychologists** *have obtained PhDs (typically five years of graduate school plus a one-year internship in a clinical setting) and are able to formally diagnose and treat mental health issues ranging from the everyday and mild to the chronic and severe*. **Counselling psychologists**, on the other hand, are *mental health professionals who typically work with people who need help with more common problems such as stress and coping; issues concerning identity, sexuality, and relationships; anxiety and depression; and developmental issues such as childhood trauma*. Counselling psychologists may have either a Master's or PhD degree and, like clinical psychologists, complete a great deal of clinical training before establishing their own practice. Practitioners of clinical and counselling psychology work in many capacities and settings. They may provide individual or group therapy in an office or institution such as a hospital, or they may conduct psychological testing and research. Other people with different levels of training and background also conduct therapy. For example, clinical social workers and psychiatric nurses conduct therapy to help people cope with psychological problems.

Psychiatrists are *medical doctors who specialize in mental health and who are allowed to diagnose and treat mental disorders through prescribing medications*. Most psychiatrists complete an undergraduate degree, four years of medical school, and a five-year residency (similar to an apprenticeship) before become independent clinicians. It is important to note that many psychiatrists understand the usefulness of the biopsychosocial perspective and perform psychological therapy in addition to prescribing medications, or work closely with other professionals who provide such services. Historically, in Canada and most U.S. states, clinical psychologists have not been allowed to prescribe medications, so in many settings psychologists and psychiatrists work together, combining medications with psychological therapies. Like clinical psychologists, psychiatrists work in a variety of settings, but they are most frequently found in hospitals and other institutional settings.

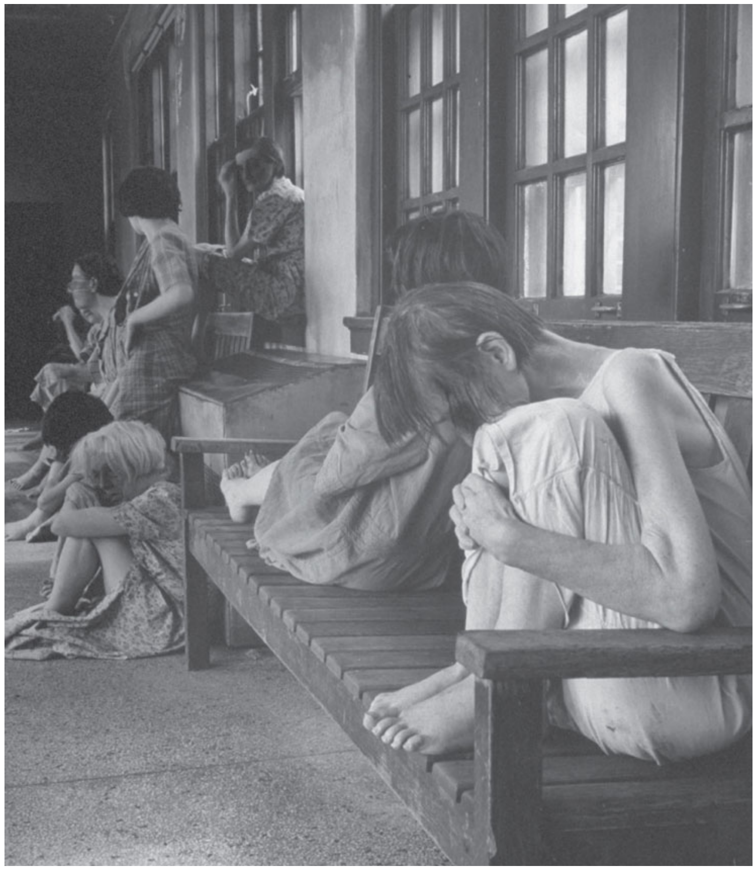
Inpatient Treatment and Deinstitutionalization

Listen to the Audio

Throughout much of human history (although certainly not in all cultural settings), people experiencing severe disorders—such as the profound disturbances associated with schizophrenia—were often separated from society and confined to an asylum. The aim was not to treat these individuals because there was no hope that they would get better. Rather, the goals were to protect the public and to provide basic care for individuals whose families could not do so (Wright, 1997).

The creation of institutions for housing the mentally unwell began in the 15th century due to rapidly growing European populations and mass migration to cities. These trends tended to disrupt the normal family and community traditions that would have provided structure to individuals′ lives and the bonds of collective responsibility that people would have had for the mentally ill members of their families. The institutions began on a rather small scale. For example, in 1403, St. Mary of Bethlehem, a hospital in London, England, admitted six patients with mental issues (Shorter, 1997). However, physicians at that time did not know how to treat psychological disorders. In many cases, the goal was to simply keep the patients away from the general public. In other cases, patients were put in restraints and underwent physical treatments that were quite painful. The hospital's treatment of these patients eventually became so awful—and the hospital was so chaotic—that *bedlam* (a mispronunciation

of Bethlehem) began to be used to refer to chaos and madness in general (Foucault, 1975).



Today, some people with severe mental disorders reside in an institution or hospital that specializes in mental health care. These settings are dramatically different than they were just a few decades ago, when they were called "insane asylums" and other unfortunate names.

Jerry Cooke/The LIFE Images Collection/Getty Images

By the end of the 19th century, psychology was gaining credibility as a science, and asylums were built both to house the mentally ill *and* to attempt to treat their conditions. Unfortunately, these asylums quickly became overcrowded, and there were not many effective treatments at the time for most disorders. Thus, despite the good intentions, in practical terms the asylums remained little more than giant warehouses that separated the mentally ill from the rest of society.

The treatment of individuals with psychological disorders changed dramatically in the 1950s and 1960s. One major contribution to the shift in attitudes toward patients was that effective treatments began to be developed for some disorders, largely in the form of medication. As patients' symptoms became more treatable, a society-wide movement toward **deinstitutionalization** occurred, which involved *the movement of large numbers of psychiatric in-patients from their care facilities back into regular society*, generally after having their symptoms alleviated through medication. The next three decades saw about an 85% decrease in the number of psychiatric inpatients (Sealy & Whitehead, 2006), both in Canada and in many other countries (Fakhoury & Priebe, 2002). Although a small subset of patients still required inpatient care, the vast majority of individuals who entered the hospital stayed for a relatively short time before they were stabilized, given medication, and sent back (ideally) to the care of their families.

In the decades since the deinstitutionalization movement began, mental health care providers have amassed many resources and strategies to help people in distress. For example, in as little as three or four days, a patient admitted after a suicide attempt may be fully evaluated, begin medication and therapy, receive education about emergency resources such as suicide hotlines, and then be released. Whereas the goal in the past was to remove the mentally ill from society, current inpatient treatment is geared toward protecting the individual patient from immediate harm while encouraging a quick and successful return to regular society. The challenge for the healthcare system is to then provide adequate outpatient treatment so that the benefits of these treatments lead to long-term recovery; unfortunately, many provincial governments are failing in this regard (Brien et al., 2015).

Of course, some people still require intensive, long-term care. In place of asylums, many chronic inpatients now live in residential treatment

centres. These centres allow inpatients to enjoy much more personal freedom, depending on the severity of their symptoms. Low-level **residential treatment centres** are *housing facilities in which residents receive psychological therapy and life skills training, with the explicit goal of helping residents become re-integrated into society*. Medium- to high-level centres have the same emphasis as low-level centres, but also place restrictions on individuals' freedoms for reasons of safety and stability. These centres function like hospitals inside medium-security prisons, with a high staff-to-resident ratio to ensure that residents' movements and freedom remain under control, with potential escapes prevented by security systems and physical barriers (e.g., locked doors that bar escape). These facilities are intended for individuals with more dangerous histories—such as incidents of physical or sexual assault.

Involuntary Treatment

Listen to the Audio

In some cases, people are required to enter the mental health system against their will. In Canada and the United States, as well as many other countries, people can be compelled through the courts or on the advice of social service agencies or doctors to be treated for mental illness or addictions. The majority of these cases arise due to the person engaging in highly erratic or disturbing behaviour, which results in legal trouble and the possibility that the person may be a risk to themselves or others.

Involuntary treatment is a very controversial issue. Those in favour of the ability of psychiatrists to have someone commited to a psychiatric ward argue that doing so ensures that people with severe disorders receive treatments that they might otherwise avoid (Hough & O'Brien, 2005; Pollack et al., 2005). It also may protect society from people who may otherwise harm themselves or other people. Those against involuntary treatment are concerned that this practice is unethical because it can restrict the freedom of people who may not have actually done anything harmful to themselves or others. It can also involve patients being forced to take medications that may alter brain function and/or have adverse side effects.

Importantly, involuntary treatment is also more common for some ethnic groups and socioeconomic classes than others (Kisely et al., 2011). A survey of records in the United States indicated that individuals who are lower in socioeconomic status and from African-American or Latino

backgrounds are significantly more likely to receive court-ordered treatment (Takeuchi & Cheung, 1998). Some of these differences may be due to the fact that poorer individuals are unable to afford treatment. In this case, a court-ordered treatment may allow them to receive help that would otherwise be unavailable. But it is also possible that different groups in society are judged differently, even if the mental-health professionals are attempting to remain unbiased.

The Importance of Community Psychology

Listen to the Audio

The deinstitutionalization movement of the 1950s and 1960s did have one unintentional negative consequence: many of the previously hospitalized patients who were released back into society did not have family or social support structures in place to help them reintegrate successfully. As a result, many mentally ill people faced problems with substance abuse, homelessness, and being victimized or traumatized by people who took advantage of their vulnerable state.

To deal with these issues, some psychologists began to place less emphasis on individual, one-on-one therapy, in favour of working with the community at large. This gave rise to a field known as **community psychology**, *which focuses on identifying how individuals' mental health is influenced by the community in which they live, and emphasizes community-level variables such as social programs, support networks, and community resource centres to help those with mental illness adjust to the challenges of everyday life*.

Through working at a community level rather than narrowly focusing on individuals, community psychologists hope to prevent or minimize the development of disorders, seeking to enhance the factors (such as healthy family relationships) that strengthen people and make them more resilient to the kinds of stresses that can otherwise undermine mental health. For example, to prevent depression, community psychologists may conduct research into the environmental and neighbourhood factors

that contribute to stress, anxiety, and depression, and then work with community groups to resolve these problems. In addition, they may develop programs to counter negative cognitive patterns and bolster positive thinking in schools and afterschool programs. These programs, along with the early detection of psychological symptoms, have had positive effects on individuals, as well as on the economic costs and the demands placed on the healthcare system (Mental Health Commission, 2014; Roberts & Grimes, 2011).

Psych@

The University Mental Health Counselling Centre

In many workplace or educational settings, mental health services are available to the population through the institution's own services. A good example is university campuses. The stresses of university life can often bring about temporary struggles with mental well-being. Students must deal with the stresses of managing a heavy workload, beginning a career path, and developing an adult identity, while also juggling work and family obligations. Some students also face lifelong struggles with mental illness. In any given year, approximately 15% to 20% of Canadian university students exhibit symptoms of depression, the majority of whom report that depression significantly affected their academics (American College Health Association, 2016). One study on first-year students at Acadia University found that 7% of male and 14% of female students experienced a major depressive disorder in their first year at school alone (Price et al., 2006). In general, mental health issues in university students seem to be on the rise. Over the past two decades, rates of depression

have increased more than 50%, with anxiety disorders and other issues also increasing (American College Health Association, 2016).

University counselling centres typically employ a resident psychologist or psychiatrist, along with a staff of trained counsellors. These centres are in great demand and often have waiting lists, with universities sometimes struggling to find the economic resources to meet the rising need for help (Gibson, 2019). Counsellors are trained to help with the more common student issues, such as stress, anxiety, time management, depression, and relationship issues, but they also often encounter students with more severe disorders than most counselling centres are designed to accommodate (Gallagher, 2007; Voelker, 2003). In these cases, counsellors can help students find appropriate mental health professionals.

University counselling centres provide much-needed psychological help to students who are struggling with different mental illnesses.

Belchonock/123RF

Evaluating Treatments

Listen to the Audio

Given the diversity of treatment approaches and settings that are available, it is important to know which approaches are effective. In the mid-1990s, the American Psychological Association set up task forces to evaluate different therapy practices and made their findings and recommendations available online to the general public (APA, 2009). This led to a call for more studies to examine the effectiveness of different therapeutic approaches, so that *evidence-based treatments* could be identified and given further financial support, such as being included in insurance companies' health insurance plans.

Empirically Supported Treatments

Listen to the Audio

Empirically supported treatments (also called evidence-based therapies) are *treatments that have been tested and evaluated using scientific methods* (Chambless & Ollendick, 2001; De Los Reyes & Kazdin, 2008). The most rigorous way of testing whether a certain therapy works is through an experiment. An experiment generally involves randomly assigning volunteers to a treatment group (e.g., a type of therapy) and to a control group. These types of experimental designs have been used to test all of the therapeutic techniques discussed in Modules 16.2 and 16.3.

However, testing the effectiveness of different therapies is not a simple matter. Ideally, experiments are double-blind, which in this case means that neither the patient nor the individual evaluating the patient is aware of which group the patient is in. However, this level of rigour is often close to impossible to attain when evaluating therapies. One common problem is that it is ethically problematic to place people into a control group that receives no treatment of any kind, because it effectively denies them treatment that they need. It is also generally impossible to use double-blind procedures, given that a therapist, of course, knows which type of treatment is being administered, and many clients likely do as well. As a result, it is very difficult to adequately test the effectiveness of many therapeutic approaches to the rigorous extent required for empirical support (DeRubeis & Crits-Cristoph, 1998).

Additionally, even though many therapists may provide the same therapy, each therapist will have a slightly different personal approach, and each combination of client and therapist will be unique. Much of the effectiveness of therapy comes from the **therapeutic alliance**—*the relationship that emerges in therapy between the therapist and the patient*. In fact, the specific type of therapy used is actually less important than factors such as empathy and trust, which allow the therapist and client to build an appropriately supportive relationship. Therapists who are more socially skilled (who show warmth, concern, and empathy) tend to be more effective. Similarly, clients who are more open to the process, more willing to trust the therapist, and more willing to recognize and work on their issues are more likely to benefit from therapy (Prochaska & Norcross, 2002).

The importance of the therapeutic alliance to the successful treatment of psychological disorders makes a great deal of intuitive sense. However, empirically based treatments are not the only method people use when coping with these disorders. The past few decades have seen an explosion of self-help literature aimed at providing a convenient and affordable alternative to structured therapy.

Working the Scientific Literacy Model

Can Self-Help Treatments Be Effective?

Listen to the Audio

Many people opt to address their psychological problems by using resources that do not involve visiting an actual therapist, such as self-help books, online information, or community workshops. Are these approaches helpful?

What do we know about the availability of self-help treatments?

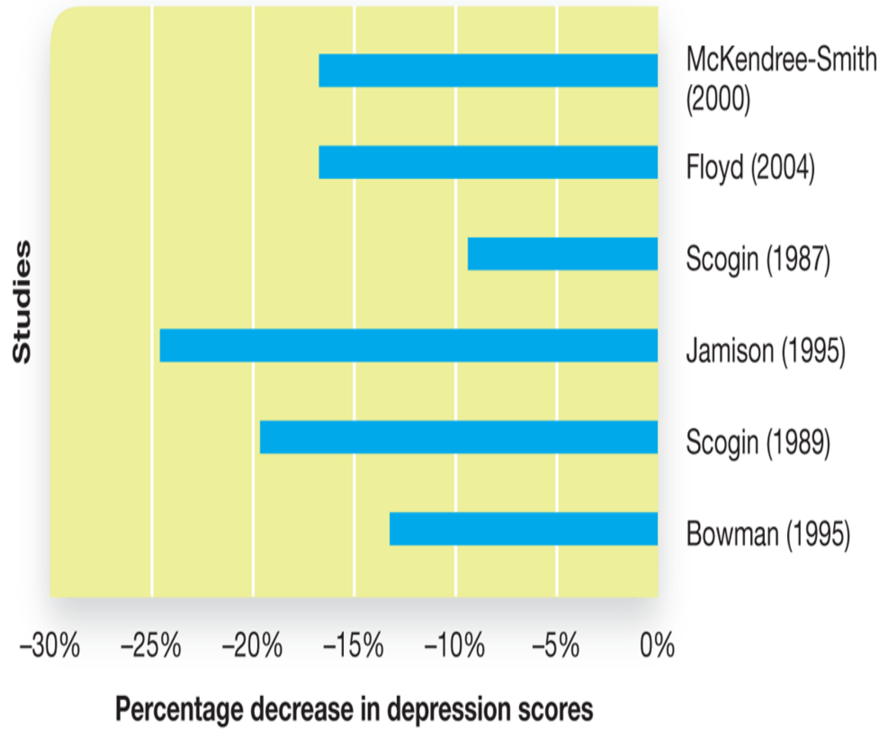
There is a huge variety of self-help materials available to the public. Just walk down to your local bookstore and check out the psychology section, where you will find books on everything from anxiety and depression to how to raise children, deal with divorce, and optimize your well-being. A quick perusal will reveal that many of these books are written by people with PhDs in the relevant fields (although many are not), but the books also do not always agree with one another on the best approach to whatever issue they are discussing. For example, if you read the popular literature on how to help children deal with emotional struggles, you could catalogue several approaches that were not only different, but actually would work against each other. Given this uncertainty, how can we tell if the material in self-help programs is actually helpful?

How can science test the effectiveness of self-help treatments?

There is some research on this issue, examining whether **bibliotherapy**, *the use of self-help books and other reading materials as a form of therapy*, improves people's symptoms. For example, one study attempted to assess the effectiveness of bibliotherapy over a three-month period in 170 elderly primary-care patients who were experiencing depression. The patients were evenly divided into two groups: both groups received a "standard care" approach, but the self-help group also read a self-help book on depression. After three months, the group who read the self-help book in addition to the standard care showed no signs of reduced depression compared to the control group (Joling et al., 2010). However, as discussed earlier, this is hardly a definitive test of the effectiveness of self-help. It's possible that a particular book wasn't effective for this population, but a different one could have been.

A slightly stronger approach to this question is to perform a meta-analysis, combining numerous studies testing a similar hypothesis. One such analysis combined six separate studies that had tested whether the book *Feeling Good* reduced depressive symptoms. The researchers found that over four weeks, those who read the book had reduced depression compared to those who had not (see Figure 16.1; Anderson et al., 2005). Thus, there *may* be reason to believe that bibliotherapy can be helpful in some situations.

Figure 16.1 Results of Six Studies Evaluating the Self-Help Book *Feeling Good*



Research on the book *Feeling Good* shows successful results in reducing symptoms of depression. Comparisons across six studies (identified by author name and publication date) indicate statistically significant improvement in each case (Anderson et al., 2005).

Source: Based on Anderson, L., Lewis, G., Araya, R., Elgie, R., Harrison, G., . . . & Williams, C. (2005). Self-help books for depression: How can practitioners and patients make the right choice? *British Journal of General Practice, 55*, 387–392.

Can we critically evaluate this evidence?

The biggest strength of the self-help literature is also its biggest weakness: there are so many books available that it is almost impossible to ensure that they are all credible sources of information. The research presented above used a single book, *Feeling Good*, as the representative of self-help books. Obviously, this is not sufficient evidence in favour of using self-help books to cope with psychological disorders (an issue that the authors of that research were quick to point out). People planning to use

self-help books should ensure that the authors have the necessary qualifications to advise people about mental health issues. If possible, they should also see if the coping strategies promoted in the book have been tested by scientists. Although the dense methods and results sections of academic articles may intimidate some readers, most articles also come with an accessible summary (known as an abstract) that provides readers with the take-home message of the study (i.e., did it work?).

The reason that caution is necessary when using self-help books is that many psychological disorders are both complex and emotionally intense. Exploring the various symptoms of a person's psychological disorder—and examining their causes—can sometimes be a difficult experience. Having a trained therapist aid you in coping with these experiences is often helpful. This is not to say that all self-help books should be avoided. Rather, it is to warn people that these books do not always prepare people for the emotions that can arise as they deal with the symptoms of their psychological disorders.

Why is this relevant?

Self-help options have major advantages over traditional approaches to therapy, which means that if they do work, even in part, this information is important to know. For example, self-help options are typically low in cost (e.g., compare $150 for an hour of therapy to $20 for a book), are convenient, and can be accessed anonymously. Furthermore, self-help options are extremely easy to find in the self-help section in the bookstore or with a quick online search for self-help programs. Indeed, many people consult online resources to get help for depression, anxiety, substance abuse problems, and sexual health (Fox, 2005).

That said, research does suggest that self-help approaches, relative to in-person therapy sessions, are less likely to lead people to actually implement changes in their own lives (O'Kearney et al., 2006). If you are experiencing psychological distress, it is probably advisable to speak with a mental health professional at least once—especially if symptoms are severe—to find out whether self-help is appropriate for your situation. A professional may also be able to suggest good resources, which can save you a great deal of wasted energy wading through stacks of self-help literature in the search for quality information.

Barriers to Psychological Treatment

Listen to the Audio

Our knowledge of psychological disorders has improved dramatically in the past 50 years, yet many people with psychological difficulties do not receive help. For example, in a 2016 study by the Centre for Addiction and Mental Health in Toronto, only 40% of adults who reported significant anxiety or depression received some form of therapy (Boak et al., 2016). In both Canada and the United States, surveys show that approximately two-thirds of people with mental health issues don't even seek professional help (Lesage et al., 2006; NIMH, 2011). Furthermore, roughly two-thirds of adults with diagnosed mood or anxiety disorders reported waiting over a year to receive a diagnosis (Cheung et al., 2017). Why would people choose not to seek help?

Difficulty Defining a “Disorder”

Listen to the Audio

One problem that almost everyone struggles with is that disorders themselves are inherently ambiguous. Thus, a person may believe they are simply sad, rather than experiencing an episode of depression. After all, sadness is a regular part of life, and not everyone who is sad needs to see a therapist. The same is true for most psychological disorders. Rather than seeking help when a person begins to experience problems, they might wait until it is so severe that they have no choice, or perhaps a loved one convinces them that they need to see a professional.

Stigma around Mental Illness

Listen to the Audio

Another common barrier is stigma toward mental illness and toward the process of therapy itself (Corrigan, 2004; Vogel et al., 2009). You may intuitively understand the effects of stigma—do you think it would be easier for a high-powered executive to take some time off work for intensive chemotherapy or inpatient treatment for severe depression? Whereas most adults say they would be open to talking about a cancer diagnosis at work, fewer say they would be open to talking about a mental health condition (see Table 16.1; Canadian Mental Health Association, 2008). Even people who would never intentionally stigmatize others can be reluctant to share their own struggles. Obviously, we still have a long way to go before mental illnesses are viewed in the same way as physical ailments.

Table 16.1 Stigma Related to Mental Illness

Percentage of people who would tell friends or co-workers that they had a family member with a mental illness.

50%

Percentage of people who would tell friends or co-workers that they had a family member with cancer.

Percentage of Canadians who would be unsure if they would associate with a friend with a mental illness.

Percentage of Canadians who would be unsure about entering into a spousal relationship with someone who had a mental illness.

Percentage of Ontario workers who would be concerned about how work would be affected if a co-worker had a mental illness.

Percentage of Ontario workers who would not tell their boss/manager if they (the worker) had a mental illness.

Percentage of Canadians who believe there is less stigma surrounding mental illness now than there was five years ago.

Percentage of Canadians who think that they are more aware of mental health issues than they were five years ago.

Source: Canadian Medical Association (2008). 8th annual National Report Card on Health Care; Bell Canada (2015). Bell Let′s Talk: The first 5 years (2010-2015).

Attitudes toward Treatment

Listen to the Audio

An additional barrier to people seeking treatment for psychological disorders is that some people do not trust the psychological or psychiatric professions and are skeptical of the usefulness and safety of different treatments (Mansfield et al., 2005; Vanheusden et al., 2008). Overcoming such skepticism may make a big difference in helping people seek treatment; for example, in one study, 99% of respondents said they would seek mental health treatment if they believed it would be helpful (Fox et al., 2001). There is an important role to be played by educational programs that help people become aware of how different problems can be treated, and help to build confidence in the mental health profession (Sharp et al., 2006).

Review Attitudes toward Seeking Professional Help

Read each item carefully and select the response that indicates the degree to which you agree or disagree with the item.

1. If I believed I was having a mental breakdown, my first inclination would be to get professional attention.

◯ Agree
◯ Partly Agree
◯ Partly Disagree
◯ Disagree

2. The idea of talking about problems with a psychologist strikes me as a poor way to get rid of emotional conflicts.

◯ Agree
◯ Partly Agree
◯ Partly Disagree
◯ Disagree

Previous | Next

Source: From "Attitudes toward Seeking Professional Psychological Help: A Shortened Form and Considerations for Research" by E. H. Fischer & A. Farina (1995) Journal of College Student Development, 36, 368-373. Copyright © 1995 by American College Personnel Association. Reprinted by permission.

Gender Roles

Listen to the Audio

In many countries, including Canada and the United States, experiencing psychological distress and going to therapy seem incompatible with the idea of a strong, independent male. This leads people to downplay problems and assume they should just power through any struggles they face. This self-reliance certainly doesn't promote talking about emotions and acknowledging vulnerabilities, steps that would put people on a path toward healing (Berger et al., 2005; Mahalik et al., 2003). In fact, getting men to see therapy differently has presented such a challenge that the National Institute of Mental Health (NIMH) in the United States has staged public awareness initiatives such as the "Real Men, Real Depression" campaign. Initial evidence indicates that social marketing messages such as this do succeed in increasing the likelihood people will seek help, perhaps partially overcoming resistance based on traditional gender roles (Bell et al., 2010; Rochlen et al., 2006).

Dwayne Johnson (aka "The Rock") has spoken about the depression he experienced when his football career ended. Having male celebrities such as The Rock speak up about his mental health struggles makes it easier for other males to seek help without fear that they will appear less masculine.

Invision/AP/Shutterstock

Culture

Listen to the Audio

People from certain cultural groups are less likely to use psychological services. In Canada, Asian Canadians and people of Indigenous descent are both less likely to seek mental health treatment than Canadians of European background (Sue & Lam, 2002). Therapy is also a more popular choice for Canadians and Americans in general relative to people from many other countries, such as Israel, Hungary, Japan, and Korea (Cohen et al., 1998; Masuda et al., 2005; Yoo & Skovholt, 2001). There are many possible reasons for these differences, ranging from the degree of stigma toward mental illness in different cultures to financial and other barriers that make access to treatment more difficult.

Some research suggests that individuals from ethnic minority groups are more likely to discuss mental health issues with their medical doctor than with a psychiatrist or psychologist (Jimenez et al., 2012). However, family physicians—although very well-educated—are not experts in treating psychological disorders. Additionally, a U.S.-based study found that many individuals belonging to ethnic minority groups would prefer to see a mental health professional from the same ethnic background; however, the same study noted that there were not enough mental health professionals to meet this need (USDHHS, 2001). Given the increasingly multicultural nature of Canadian society, this barrier to treatment will likely become increasingly important.

Geographical Barriers

Listen to the Audio

Some of the cultural barriers related to receiving treatment are also related to Canada's geography. According to recent statistics (Statistica, 2017), 81% of Canadians live in cities where people may take for granted their easy access to health care. This is not the case in rural settings, particularly in Northern communities. Research conducted at the University of Northern British Columbia identified a number of issues that are unique to Canada's remote communities (O'Neill, 2010). These include the mental health problems associated with isolation, poverty, and the challenge of maintaining traditional cultures in a rapidly changing world. Unfortunately, rural areas in Canada are also experiencing problems attracting (and keeping) mental health professionals. If there is a mental health professional in a small community, patients and therapists may have frequent social contact. The therapist would therefore have to juggle a number of different roles (e.g., therapist, neighbour, friend; Barbopoulos & Clark, 2003). Not surprisingly, psychologists in rural regions—particularly in remote areas—experience high rates of burnout and often leave remote rural areas after a few years (Schmidt, 2000). As a result, individuals in rural regions have less access to psychological therapies than Canadians living in cities.

Financial Barriers

Listen to the Audio

Not everyone can spare the time and money for treatment (Colonna-Pydyn et al., 2007; Craske et al., 2005). Unfortunately, government healthcare coverage in Canada generally only includes treatment by psychiatrists, leaving counsellors, psychologists, and many types of therapists less able to reach many people who can't afford their services. As a result, psychotherapy can be very expensive, generally costing more than $100 per hour. Therapy is also associated with numerous indirect costs, such as time away from work, transportation, and possibly childcare. The net result of these sorts of funding decisions is to place greater emphasis on the medical approaches to treating psychological disorders (i.e., medications). Although the medical approach is ideal for some disorders, there are situations where patients would benefit if greater emphasis were placed on learned skills such as how to effectively manage emotions, improve relationships in the family, or deal with stress. Psychologists and counsellors would be able to help in these situations.

To help overcome financial barriers, community mental health centres sometimes provide therapy on a sliding scale, which means the cost of a one-hour session varies depending on the patient's income and whether they have additional health benefits from employers that would cover some of the therapy costs. Drug treatments can also be made more affordable by using generic products rather than brand-name ones.

The cumulative impact of the barriers to psychological treatment leaves millions of people delaying or simply never receiving the kind of therapy and support that could seriously improve their lives (Wang et al., 2005). Understanding these barriers is an important step toward overcoming them.

Module 16.1 Summary

Listen to the Audio

16.1a Know . . . the key terminology associated with mental health treatment.

Review Module 16.1

Start Over Swap

0/9 REVIEWED · 0 MASTERED

clinical psychologist

Previous Next Got It!

16.1b Understand . . . the major barriers to seeking help for psychological disorders.

These barriers include expense, availability (which is related to one's geographical location), gender, and attitudes toward therapy, which are

often influenced by the stigma against therapy that may be held by a particular group (e.g., males and some cultural groups).

16.1c Understand . . . the arguments for and against involuntary treatment.

Proponents argue that such treatment improves mental health and ensures that people with severe disorders receive appropriate treatment. In severe cases, involuntary treatment may also help to protect innocent people from individuals who are potentially violent. Opponents argue that the benefits of involuntary treatment are limited and may result in the patient feeling coerced or resentful.

16.1d Apply . . . your knowledge to suggest what approach to therapy is likely most appropriate for a given situation.

The appropriate kind of therapeutic setting depends on a host of factors, including the psychological disorders that require treatment, the individuals' location, and their ability to afford medications or therapy. For common problems such as stress and milder forms of depression and anxiety, seeing a counselling psychologist is likely a good first step. Most universities offer counselling services for students on campus. For more severe and debilitating problems, such as severe anxiety, depression, or schizophrenia, a clinical psychologist or psychiatrist is likely most appropriate. A psychologist will likely engage in a form of psychological therapy, whereas a psychiatrist will likely take a more physiological approach involving prescribing medication.

Apply Activity

Study the table. Then, select "Check Your Understanding" to test your knowledge on which type of therapist each individual should consult.

Diane has an intense fear of driving. This has limited where she can live and what social activities she can join.	Clinical psychologist
Max was recently released from prison and is having difficulties adjusting to the outside world. He doesn't have a job or much social support and is feeling anxious and depressed.	Community psychologist
Alyssia has been diagnosed with depression, but is experiencing problems with the medication she has been prescribed.	Psychiatrist
Nathan has been having problems sleeping and has lost his appetite. These symptoms have become worse now that his university exams are coming up.	University counselling service

Check Your Understanding

16.1e Analyze . . . whether self-help options, such as popular books, are a useful therapy option.

Self-help books alone are not likely to be life-changing or good stand-alone treatments for serious problems such as major depression, anxiety, and substance abuse. Even so, research on bibliotherapy indicates that in some cases, when used in conjunction with other methods, reading self-help books can bring about modest improvements. It is, of course, always possible that for a specific individual, any specific self-help book may be profoundly helpful and even life-changing; however, on average, reading self-help books has only a small therapeutic benefit.

Module 16.2 Psychological Therapies

Listen to the Audio

wavebreakmedia/Shutterstock

Learning Objectives

16.2a Know . . . the key terminology related to psychological therapies.

16.2b Understand . . . the general approaches to conducting major types of psychological therapy.

16.2c Apply . . . your knowledge to identify major therapeutic techniques.

16.2d Analyze . . . the pros and cons of the major types of psychological therapy.

Medical doctors are generally required to follow the Hippocratic Oath—a pledge that they will cause no harm to their patients. One way of honouring this oath is to use the safest and most effective treatments. Although we do not generally associate the Hippocratic Oath with psychologists, they also follow the basic tenet, seeking to use techniques that are safe and do not cause harm to their clients. If there is a possibility that a specific type of treatment might worsen a condition, this treatment should therefore be avoided, unless there are no better options.

For example, Scared Straight was a program developed in the 1970s that involved exposing at-risk youth to prisons and prisoners. The interventions were based on the premise that shocking or scaring the youths with the harsh realities of prison life would deter criminal activity. These scare tactics involved blunt descriptions of prison violence, along with verbal aggression directed at adolescents attending the sessions. The program may have succeeded in scaring and shocking adolescents, but the youths who attended these sessions did not necessarily go down a straight path. Many were later convicted of crimes and incarcerated. In fact, if anything, the program seemed to backfire; according to some analyses, participants in the program

showed an increased chance of subsequently committing crimes (Petrosino et al., 2003).

Scared Straight and other methods for helping people can, unintentionally, do more harm than good (Lilienfeld, 2007). Although a rare case, this example reminds us that therapy can be performed in many different ways, and we should be cautious in determining which methods are best.

In Module 16.1, we introduced psychological therapy as a set of processes for resolving personal, emotional, behavioural, and social problems and improving well-being. Psychological therapy is a broad term, and mental health providers have a number of therapeutic approaches to choose from. In this module, we will study several of these approaches. Although the methods are diverse, they are all types of psychological therapy, rather than biological or medical therapy. In psychological approaches, techniques for resolving problems rely heavily upon communication between client and therapist.

Insight Therapies

Listen to the Audio

Psychologists have long believed that self-knowledge and understanding can lead to positive changes in behaviour. This is certainly the case for **insight therapies**, which is *a general term referring to therapy that involves dialogue between patient and therapist for the purposes of gaining awareness and understanding of psychological problems and conflicts*. Historically, the formal beginning of insight therapy came with the development of psychoanalysis by Sigmund Freud and its evolution into **psychodynamic therapies**, *forms of insight therapy that emphasizes the need to discover and resolve unconscious conflicts*.

Psychoanalysis: Exploring the Unconscious

Listen to the Audio

In the mid-1880s, Freud was setting up a neurological practice in Vienna. Many of his early patients were young women who were suffering from physical symptoms such as shaking, sleep problems, or even partial paralysis; however, there did not appear to be any biological cause that could explain these symptoms. Psychoanalysis began as part of Freud's attempt to identify psychological factors that could produce these physical symptoms.

One possibility that Freud quickly embraced was the idea that humans have both *conscious* motivations that we are aware of as well as *unconscious* motivations that can influence our behaviour without our knowledge. As described in Module 12.3, Freud hypothesized that many of the factors that motivate us include biological urges, such as sexuality and aggression, which are socially unacceptable in most forms. Rather than act on all of these impulses, we use psychological defences to keep them out of our conscious experience. Freud believed that psychoanalysts should help patients become aware of these unconscious urges. Doing so would allow patients to gain insight into their psychic conflicts. This understanding was believed to free patients from the grips of the previously unknown forces that were impacting their lives. Freud and his followers based their practice on some core ideas summarized in Table 16.2.

Table 16.2 Core Ideas Forming the Basis of Psychoanalysis

Table 16.2 Core Ideas Forming the Basis of Psychoanalysis

• Adults' psychological conflicts have their origins in early experiences.
• These conflicts affect the thoughts and emotions of the individual, and their source often remains outside of conscious awareness.
• The unconscious conflicts and their effects are called neuroses (anxieties).
• By accessing the unconscious mind, the analyst and patient can gain a better understanding of the early conflicts that led to neuroses.
• Once the conflicts are brought to the surface, the analyst and the patient can work through them together.

Gaining access to the unconscious mind is tricky business; by definition, the patient doesn't know what's there. As a result, Freud and his followers invented several methods they believed would help them access the mysterious unconscious realm. One of the primary techniques is **free association**, *during which patients are encouraged to talk or write without censoring their thoughts in any way*. Instead, the person allows everything that pops into their mind to come spilling out, no matter how odd or meaningless it may seem. Freud believed that this uncensored stream of consciousness would reveal clues to the unconscious in ways that patients may not normally be able to access.

The second is dream analysis. Freud believed that in the relatively unguarded dreaming mind, the unconscious would be better able to express itself. Because it doesn't communicate through language as the conscious mind does, Freud reasoned that it expresses itself through symbols that need to be properly interpreted. **Dream analysis** is *a method of examining the details of a dream (the manifest content), in order to*

gain insight into the true meaning of the dream, the emotional, unconscious material that is being communicated symbolically (the latent content). Dreams take the form of imagery (sometimes bizarre and confusing), but within them, Freud believed were hidden desires. The psychoanalyst's role was to help patients properly understand these symbolic truths in order to gain insight into their unconscious conflicts.

For example, consider one of Freud's best known dream analyses: A patient dreamed he was riding his bicycle down a street when suddenly a dachshund (a type of dog) ran him down and bit his ankle as he attempted to pedal away. Meanwhile, two elderly ladies sat by and laughed at the incident. The details described are the *manifest content*, but what might the dream *mean*—what is the *latent content*? Freud pointed out that in his waking life the patient had repeatedly seen a woman walking a dog and, although he was very attracted to her, he felt great anxiety about approaching her. The man had consciously devised a plan to use the dog as an excuse to strike up a conversation with the woman. Unfortunately, the anxiety caused by fear of rejection manifested itself in an unpleasant dream about being attacked by a dog, accompanied by the humiliation of being laughed at (Freud, 1920). (How Freud would have reacted to the fact that English speakers also call dachshunds "wiener dogs" is a question best left to historians.)

The third strategy is to pay attention to signs of resistance. **Resistance** *occurs in therapy when the patient engages in strategies that keep unconscious thoughts or motivations that they wish to avoid from fully entering conscious awareness*. Resistance may be subtle, such as the patient using humour to avoid talking about something painful, or it may be obvious, such as the patient skipping sessions, becoming angry at the psychoanalyst, or becoming cynical about the whole process. This behaviour is actually considered a promising signal for the psychoanalyst because it means that they are beginning to access the unconscious motives of the clients'

present difficulties. Psychoanalysts then attempt to push through the resistance by making patients aware of how and what they are resisting.

A fourth tool used by psychoanalysts involves **transference**, *whereby patients direct certain patterns or emotional experiences toward the analyst, rather than the original person involved in the experiences (e.g., their parents)*. For example, if a patient is addressing a hidden sexual conflict, then transference may occur through them developing sexual feelings for the analyst. Or as another example, if a patient's mother made them feel excessively criticized during childhood, they may tend to see the analyst's behaviours as being critical in a similar way, and respond defensively as though being attacked or criticized. Thus, the patient's interaction with the analyst becomes a kind of stage on which conflicts with other people are revealed and explored. Transference is a significant milestone in the process of psychoanalysis. Once it is reached, the analyst and patient can begin to work through specific problems and to discuss ways of coping with them.

In sum, there are many different techniques that psychoanalysts draw upon, including transference, resistance, dream analysis, and free association, that can help to provide direct knowledge of the person's otherwise inaccessible unconscious. Once this material is brought to the light of the patient's conscious awareness, these patterns can begin to be examined and, ideally, changed.

Review Activity Match the Psychoanalytic Element with Its Description

---

Match the psychoanalytic element to its description.

Transference	Noticing when a client directs emotional responses toward the analyst rather than toward the person involved in the actual experiences
Resistance	Noticing when a patient uses strategies such as jokes that help them keep their unconscious motivations from entering conscious thought
Free Association	Asking a patient to talk or write down whatever comes to mind; the analyst then examines this output for clues to their unconscious motivations
Dream Analysis	Searching for symbols in a patient’s dreams

Check Your Understanding

Modern Psychodynamic Therapies

Listen to the Audio

Today, Freudian-based psychoanalysis is practised by relatively few therapists. Nevertheless, Freud's ideas have remained influential and several newer therapies have evolved from traditional psychoanalysis. In contrast to Freudian methods, these new approaches are more concerned with the client's conscious rather than unconscious experience. They also acknowledge the effect of cultural and interpersonal influences on individual behaviour, and the impact of important needs such as love, power, belonging, and security. Finally, they are more optimistic about people's ability to reach healthy functioning.

One example is **object relations therapy**, *a variation of psychodynamic therapy that focuses on how early childhood experiences and emotional attachments influence later psychological functioning* (see Module 10.2). In contrast to psychoanalysis, object relations therapy does not centre on repressed sexual and aggressive conflicts. Instead, the focus is on "objects," which are the clients' mental representations of themselves and important others. The basic view is that the quality of the early relationship between the child and these "objects" results in the development of mental models for the child. These mental models act to shape the person's perceptions and interpretations in relationships, the general consequence being that the person will tend to form and maintain relationships as an adult that are consistent with the mental models that were formed in childhood. The mental models tell the person what is "normal" and provide an interpretive framework within which to

make sense of relationships. The therapist's job is to help the client understand these mental models and the relationship patterns they represent and reinforce. This generally leads to working with relational issues of trust, fear of abandonment, dependence on others, and other relationship factors.

Humanistic–Existential Psychotherapy

Listen to the Audio

An important new movement in psychotherapy arose during the 1950s, when humanistic psychologists broke from psychoanalytic approaches over several deep differences in their assumptions about people and the theoretical foundation upon which they were building. This humanistic–existential approach can be characterized by at least five key differences from the psychodynamic approaches (listed in Table 16.3). Overall, this new orientation emphasized individual strengths and the potential for growth, and assumed that human nature is fundamentally positive, rather than the essentially negative perspective advanced by psychoanalytic approaches. This shift toward the positive was believed to help individuals access their own sense of personal agency for overcoming their problems.

Table 16.3

Contrasting Psychoanalytic and Humanistic Views of Major Psychological Issues and Debates

Table 16.3

Contrasting Psychoanalytic and Humanistic Views of Major Psychological Issues and Debates

Issue	Psychoanalysis	Humanistic Therapy
Conscious versus unconscious	Focuses on unconscious drives	Focuses on conscious experience
Determinism versus free will	Behaviour is determined by repressed sexual and aggressive instincts	Behaviour is chosen freely
Weaknesses versus strengths	Everyone has neuroses	Everyone has strengths
Responsibility for change	The analyst interprets and explains to the client what is wrong	The therapist asks the client what is wrong and attempts to help clarify issues
Mechanism of change	Insight into unconscious conflicts allows problems to be worked through	Unconditional positive regard allows a person to heal and become more authentically themself

Humanistic and existential therapies share many similarities: to help people express their authentic selves, to overcome alienation, to become more loving, and to take responsibility for their experiences so that they learn to dwell fully in the present. The major difference between them is that humanistic therapists focus on removing the obstacles that prevent self-actualization from unfolding naturally. Existential therapists, on the other hand, emphasize the importance of facing painful experiences such as feelings about isolation, death, and meaninglessness, believing that self-actualization involves transforming by facing one's fears and negativity. Even though attaining insight is still an important aspect of these therapies, rather than interpreting the hidden meanings of dreams and free associations, the therapist's role is to listen empathically in order to understand the clients' internal world. This is referred to as a **phenomenological approach**, which means that *the therapist addresses the clients' feelings and thoughts as they unfold in the present moment, rather than looking for unconscious motives or dwelling in the past*.

American psychologist Carl Rogers (1902–1987) developed a version of humanistic therapy called **client-centred therapy** (or **person-centred therapy**), *which focuses on individuals' abilities to solve their own problems and reach their full potential with the encouragement of the therapist*. As a humanist, Rogers believed that all individuals could develop and reach their full potential. However, people experience psychological problems when others impose *conditions of worth*, meaning that they appear to judge or lose affection for a person who does not live up to expectations (Rogers, 1951). Conditions of worth are imposed, for example, by a father who only pays attention or gives praise or encouragement when his child is doing well at something, or who expresses disappointment in the child if they do something wrong, focusing more on the child's character failings or lack of will than on the actual behaviour itself and what caused it. If people give the impression that their respect and love for a person are contingent upon the person behaving in certain ways or meeting certain expectations, then they have imposed conditions of worth. Conditions of worth can impact psychological health over the long term, because they increase insecurities within the individual. As a result, the person is likely to change their behaviour in an attempt to regain affection. If this happens frequently, then the individual's behaviour starts to be primarily about gaining affection and approval, living in order to please others rather than being able to express their own authentic self. That, to Carl Rogers, is a key aspect of most psychological dysfunction.

Emotion-focused therapy (EFT) is one promising type of person-centred therapy that has evolved from the humanistic–existential tradition. EFT is based on the well-supported belief that it is better to face and accept difficult emotions and thoughts than to bottle them inside (Greenberg, 2004; Hayes et al., 2006). Therapists employing this form of therapy aim to help clients overcome their tendency to suppress disturbing thoughts and emotions, so that clients are less defensive overall and have fuller access to their whole range of experiences and emotions.

The most important aspect of all client-centred therapies lies within the dialogue that unfolds between therapist and client. The therapist must show unconditional positive regard through genuine, empathetic, and non-judgmental attention. If the therapist can remove all conditions of worth, clients may begin to express themselves without fear and begin to develop inner strength. Finally, with self-confidence and strength, clients can accept disagreements with others and focus on living their lives to the fullest.

Watch Humanistic Therapy

Evaluating Insight Therapies

Listen to the Audio

As discussed in Module 16.1, from an evidence-based perspective, therapies should be used only if there is empirical support that they actually work. Psychodynamic therapies meet some of the criteria for empirically supported therapies, though surprisingly few studies in this area have been conducted with proper research designs and control conditions. Ultimately, the effectiveness of insight therapies depends on the condition being treated. The best-designed studies have generally shown that psychodynamic therapy is not effective in treating schizophrenia, but it has shown promise for treating panic disorder, dependence on opiate drugs (e.g., heroin), and borderline personality disorder (Gibbons et al., 2008). Psychodynamic therapy may help with depression, particularly if combined with drug treatment—an approach we will describe in greater detail in Module 16.3.

For less severe conditions, such as mild depression and anxiety, behavioural issues such as dysfunctional habits or motivation and goal-striving difficulties, insight-focused therapies can often make a difference, helping individuals gain understanding and awareness of the nature of their psychological problems. Many people with psychological disorders are able to learn to function effectively without digging deeply into possible "root causes," but instead by cultivating new, more adaptive behaviours (Weisz et al., 1995).

Research shows that Carl Rogers was accurate in emphasizing the importance of the therapeutic relationship for successful therapy (Horvath & Bedi, 2002; Wampold, 2001). In fact, a strong alliance is a good predictor of successful therapy *over and above* the specific type of therapy delivered, and positive regard (Farber & Lane, 2002) and empathy are both related to therapeutic success (Bohart et al., 2002).

Research is somewhat inconsistent on the effectiveness of person-centred therapy more generally, although this therapy is reliably more effective than no treatment at all (Greenberg et al., 1994). As discussed earlier, one complicating factor in this research may be the skill of therapists themselves. Some therapists may be highly skilled at connecting with clients and establishing good rapport in therapy, whereas others may be less capable in these ways. This difference in therapists' skill could account for these mixed findings, and makes it difficult for research studies to then accurately assess the effectiveness of an approach like Rogers'.

Behavioural, Cognitive, and Group Therapies

Listen to the Audio

Behavioural therapies *attempt to directly address problem behaviours and the environmental factors that trigger them*. At the heart of behavioural therapies is the belief that patterns of behaviour are the result of conditioning and learning that have led to the automatization of maladaptive habits. In other words, through processes such as reinforcement and punishment, some individuals have learned to respond in ways that may be harmful to their physical or mental well-being. Behavioural approaches seek to recondition clients, training them to adopt different behavioural responses to situations until they develop new, more functional, habits.

Watch Behaviour Therapy

Systematic Desensitization

Listen to the Audio

How behavioural therapy works is clearly illustrated by its application to a very common problem: fear of public speaking. Most people experience at least some anxiety about public speaking, but for some, their reaction is so intense that even thinking about making a speech can bring on major anxiety, arousal, and even panic attacks.

To help people learn to handle such an anxiety-inducing situation, therapists will often employ a behavioural technique known as **systematic desensitization**, in which *gradual exposure to a feared stimulus or situation is coupled with relaxation training* (Wolpe, 1990). First, the client is guided toward being able to identify and track their own feelings of anxiety versus relaxation, so that they gain greater awareness "in the moment" of when they are feelings anxious and, critically, what it feels like when those feelings subside. Once the client has this kind of inner awareness, the therapist will expose them to a very mild version of the fear-inducing situation, such as imagining walking up to the front of the room where they are going to give the speech. As the client engages in this exercise and feels anxiety starting to rise, they practise relaxing or engaging in behavioural strategies (e.g., pausing in their imagination, practising a breathing exercise in order to calm down) in order to counteract the anxiety. With practice, the anxious response to that particular trigger will lessen, and the client then progresses to more realistic and concrete manifestations of the situation, each time practising relaxing until they can learn to tolerate the feelings and counteract them

with a relaxation response. This escalation of the intensity of the triggering experience continues slowly, step-by-step, until the client can eventually handle the real thing. This process is described in detail in Table 16.4.

Table 16.4 Applying Steps of Systematic Desensitization to Fear of Public Speaking

Table 16.4 Applying Steps of Systematic Desensitization to Fear of Public Speaking

1. Build an anxiety hierarchy. This involves the therapist assisting the client in creating a list of stimuli that arouse fear responses, starting with the stimulus or situation that evokes the least amount of anxiety and ending with the stimulus that elicits the most anxiety.
Think about and visualize:
1. Thinking about the presentation topic
2. Writing down ideas for the presentation
3. Doing library research for a presentation
4. Preparing slides and note cards
5. Practising the presentation alone
6. Practising the presentation with a few friends
7. Travelling to campus to give the presentation
8. Sitting in the classroom waiting to be called for your turn
9. Walking up to the front of the room
10. Standing up at the podium and looking out at the audience
11. Beginning to speak; delivering the first couple of lines
2. Relaxation training. During this phase, the client learns to respond to relaxation suggestions from the therapist as they begin to work through the hierarchy. This is typically done using mental imagery while the client is visiting the therapist's office; actual props may be used in some cases (e.g., a podium that the person can stand in front of).
3. Work through the hierarchy. Steps 1 and 2 are combined here as the therapist works through the entire hierarchy, usually over several sessions, until the client is able to manage the anxious feelings while continuing to engage in the relevant behaviours.

In some cases, clients may undergo a process called *flooding*, in which the client goes straight to the most challenging part of the hierarchy, exposing themself to the scenario that causes the most anxiety and panic. For example, they may elect to give a long speech in front of 100 strangers. By diving right in and (one hopes) discovering that there are no truly negative consequences, the person may find that they have "gotten over it" and lesser forms of the same activity no longer give them anxiety.

It should be noted that this is rarely used, as it can easily overwhelm the person instead and simply reinforce their anxious response.

At the opposite end of the spectrum, clients may find it difficult to even begin to expose themselves to the simplest steps of their anxiety hierarchy. Fortunately, consistent with research on observational learning or “modelling” (see Module 6.3; Bandura, 1977; Olsson & Phelps, 2007), even less threatening steps of an anxiety hierarchy can be established using other people instead of oneself in the anxiety-provoking situation. Watching others engage in the anxiety-provoking situation without suffering negative consequences can help people with severe anxiety reactions, such as phobias, learn to tolerate some mild exposure to the feared stimulus.

In a similar vein, recent advances in virtual reality technology are providing new tools for therapists. For example, it is becoming possible to help clients overcome fear reactions in a virtual setting, an advance that holds exciting new possibilities.

Working the Scientific Literacy Model

Virtual Reality Therapies

Listen to the Audio

Systematic desensitization techniques have long been a part of behavioural treatments for fear and anxiety. However, there are some key barriers that can prevent them from being effective. For one, people with fear and anxiety about a specific object or situation usually avoid any contact with it—so even taking the first step toward a therapist's office can be challenging. Also, although mental imagery is typically the method employed with these therapeutic techniques, it may not transfer well to the actual anxiety-provoking situation because mental imagery may not have the same power as the much more vivid, real situation. Virtual reality technology is offering one potential way around these problems.

What do we know about virtual reality exposure?

Virtual reality exposure (VRE) is *a treatment that uses graphical displays to create an experience in which the client seems to be immersed in an actual environment*. The virtual reality environment is much more vivid than mental imagery. In fact, the realism of the virtual worlds are improving quite rapidly as technology companies improve their virtual reality devices for the gaming industry. Importantly for psychology patients, VRE has shown great promise in helping people learn to relax in the face of their

fears (Riva et al., 2016). Specifically, virtual reality therapy may help to reduce a person's tendency to use avoidance strategies (Foa et al., 2006). As an example of VRE at work, over the past decade, this technology has become increasingly common in helping soldiers returning from military conflicts in Iraq and Afghanistan—many of whom have developed posttraumatic stress disorder (PTSD).

How can scientists study virtual reality exposure?

Psychologists at Emory University in Atlanta have been using a simulator called Virtual Iraq, which was developed to deliver two possible scenarios—being in a Middle Eastern city or driving a Humvee through a desert road in simulated war conditions (Figure 16.2). The weather, time of day, background noise, civilians, aerial craft, and ground vehicles can be programmed by the therapist to change as desired during the exposure sessions. There is also the option to provide simulated gunfire and bomb explosions. Smell cues are available using an air compressor that pumps in odours of burning rubber, garbage, diesel fuel, and gunpowder (Cukor et al., 2009).

Figure 16.2 Virtual Reality Exposure

Combat veterans diagnosed with PTSD have participated in virtual reality therapies involving simulated exposure to traumatic events. Therapists work with clients to help them process and cope with their fears.

Erika Schultz/MCT/Newscom

In one set of trials, 20 soldiers who were diagnosed with PTSD following combat activity underwent VRE therapy. Their PTSD symptoms were measured before and after therapists guided them through VRE treatment in the Virtual Iraq simulator. At the conclusion of their therapy, the soldiers' PTSD symptoms declined by 50%, with 16 of the soldiers no longer meeting the criteria for the disorder (Rizzo et al., 2010). The results included fewer disturbing thoughts about stressful events that occurred during military service; fewer disturbing dreams; reduced physical reactions such as heart pounding, sweating, and trouble breathing; and less avoidance of activities that triggered

memories of military service. VRE using the Virtual Iraq simulator appears to work.

Can we critically evaluate this evidence?

From an experimental standpoint, this study should have used a placebo (control) group that received no treatment, or a comparison group that received some other treatment method. In fact, such studies have recently occurred. In one study of U.S. veterans who had served in Iraq or Afghanistan, the effectiveness of VRE sessions was compared to the standard approaches (e.g., prolonged exposure therapy, among other standard treatments), and the VRE approach outperformed the standard approaches (McLay et al., 2011). However, VRE is not always the best treatment for patients. A 2017 study found that for patients who were experiencing combat-related PTSD, VRE was most effective for younger males who were at risk for committing suicide and who were not on antidepressant medications (Norr et al., 2017). The fact that researchers can now identify the groups who would benefit most from programs such as Virtual Iraq is important, as it will provide psychologists and psychiatrists with more precise information about which treatment is best for each patient.

It is not clear from these studies whether VRE therapy would be beneficial for disorders other than PTSD. However, other research has shown that virtual reality approaches are useful for helping people in many circumstances, including symptom reduction in people with various phobias (Opriş et al., 2012; Powers & Emmelkamp, 2008), stress management in patients with cancer (Schneider et al., 2011), and body image issues in clients with eating disorders (Riva, 2005). Indeed, a recent review of 14 VRE clinical trials found that this treatment technique caused significant reductions in the symptoms of people who experience phobias (Morina et al., 2015). These results suggest

that VRE treatments are a promising treatment option for a number of psychological disorders.

Why is this relevant?

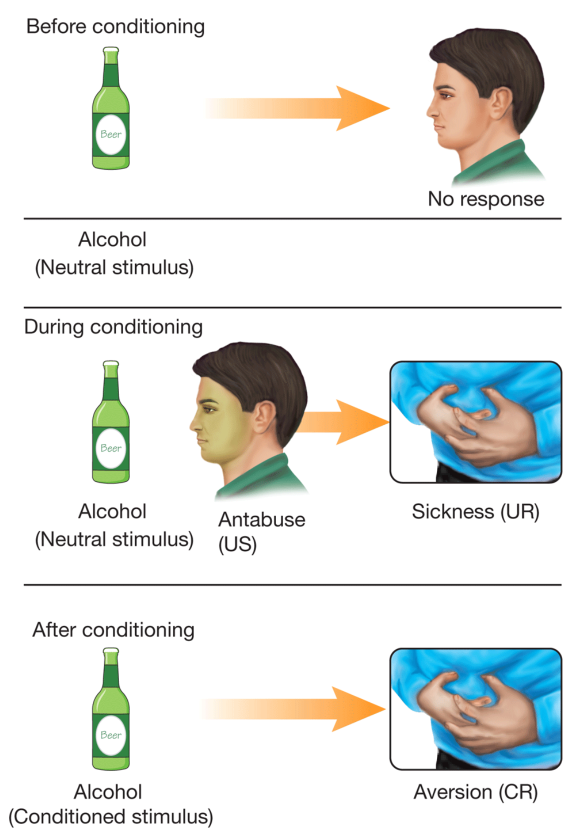
Virtual reality technologies seem to help overcome key barriers to therapeutic effectiveness. As discussed earlier regarding PTSD, clients typically avoid any stimuli associated with the original trauma, and therefore may be resistant to therapy that will expose them to the trauma. VRE approaches can get around this resistance because the therapist has precise control over the way the client will be exposed to the feared situation and can therefore easily tailor the approach to the client's needs (Hodges et al., 2001).

Aversive Conditioning

Listen to the Audio

Most people have at least one behaviour they would like to reduce or eliminate, perhaps a nervous habit such as fingernail biting or an unhealthy behaviour such as smoking. Behavioural principles tell us that these habits are maintained because they bring rewards in some fashion, and thus, changing their rewarding nature can lead to changing the behaviour itself (see Figure 16.3).

Figure 16.3 Aversive Conditioning



One method of treating patients who perform unhealthy behaviours such as smoking is to use conditioning techniques. If an unhealthy behaviour becomes associated with a negative outcome such as physical discomfort, the individual may become less inclined to perform that behaviour.

Aversive conditioning is *a behavioural technique that involves replacing a positive response to a stimulus with a negative response, typically by using punishment*. One aversive conditioning treatment involves using the drug Antabuse (disulfiram) to reduce problem alcohol consumption. Antabuse causes nausea and vomiting when combined with alcohol, so the drug classically conditions an aversion to alcohol. Antabuse works for some individuals, but there are several reasons why it is not entirely effective (Garbutt, 2009). As you can imagine, the client must have a fairly strong motivation to quit, and must be willing to take the drug knowing that it would make them ill. If they cheat and skip the drug one day, then the treatment will not have much chance of working. Thus, even though aversive conditioning can help people quit, it can require a great deal of willpower to use effectively.

The drug Antabuse is used in aversive conditioning for alcohol consumption. When it is taken and the person subsequently consumes alcohol, Antabuse causes nausea and vomiting. If successful, Antabuse treatment leads to a conditioned aversion to alcohol.

Monika Olszewska/Shutterstock

Cognitive–Behavioural Therapies

Listen to the Audio

Behavioural therapies, despite their effectiveness at changing problem behaviours, do not directly address problematic thoughts. This is extremely important because some disorders, such as depression, are caused and maintained, in part, by dysfunctional habits of thinking. Two psychodynamically trained psychologists, Albert Ellis (1962) and Aaron Beck (1963), found that people with depression tend to interpret and think about their lives in a negative light. As Ellis, Beck, and others learned more about these thought patterns, it became apparent that therapies should be directed at changing negative cognitions into more realistic and rational thought patterns, as well as helping people learn to control the physiological processes (e.g., arousal) that reinforce negative thinking. Over time, this new approach became known as cognitive–behavioural therapy.

Cognitive–behavioural therapy (CBT) *is a form of therapy that consists of procedures such as cognitive restructuring, stress inoculation training, and exposing people to experiences they may have a tendency to avoid*, as in systematic desensitization (NIMH, 2009). Because avoiding thoughts and stressful situations tends to reinforce the negative feelings that would arise, helping clients to face negativity allows them the opportunity to gain insight into their feelings, to practise a courageous response to negativity, and to learn methods for coping when negativity arises. This type of therapy is far more about the present than about the past. Rather than excavating past traumas or conflicts, CBT therapists help clients

become more aware of the thought, emotion, and behaviour patterns that arise in their current lives. Through this heightened self-awareness, clients learn to identify their habitual dysfunctional tendencies, and then work on building more functional cognitive and behavioural habits.

At the behavioural end of CBT, clients are given exercises and guidance in gaining skills they may be lacking. For example, as with systematic desensitization, clients may learn relaxation techniques, enabling them to better tolerate negative feelings when they arise. A person with social anxiety who has difficulty integrating into social situations may learn and practise certain social skills, such as making "small talk" with people at parties or learning to be more responsive to people's non-verbal cues.

At the cognitive end of CBT, clients are given exercises and strategies to build more functional cognitive habits. Cognitive restructuring involves learning to challenge negative thought patterns, to question self-defeating beliefs, and to view situations in a different light. For example, people with depression or anxiety disorders often hold extreme and irrational beliefs, such as "I can't do anything right," "I have nothing worthwhile to say," "If I fail, it's going to be a total disaster." As they become more aware of these negative beliefs, they can question or dispute them, helping themselves appreciate that these beliefs are far more negative than reality warrants. After all, nobody can do *everything* wrong; nobody has literally *nothing* worthwhile to say; and a failure is not "the end of the world," so to speak, but is also an opportunity to learn and improve. An example of applying CBT strategies to the cognitive symptoms of depression is shown in Table 16.5.

Table 16.5

Applying Cognitive–Behavioural Therapy to the Cognitive Symptoms of Depression

Table 16.5 Applying Cognitive–Behavioural Therapy to the Cognitive Symptoms of Depression

Cognitive Symptoms	Example of CBT Coping Strategy
Internal attributions: blaming oneself excessively for negative things that happen.	Recognize the role that a person contributed to their problem, but also examine the role of other contextual factors (e.g., the situation, the behaviour of other people).
Stable attributions: assuming that situations are permanent and irreversible.	In order to highlight the temporary nature of a person's difficulties, provide examples of how things that were true in the past are no longer the case.
Global attributions: assuming that the results of one negative event will apply to all aspects of a person's life.	Challenge the person to explain exactly how the effects of one negative event will spill over into other parts of the person's life; provide examples of situations when spillover did *not* occur.

Of course, it falls to the client to put the behaviours learned in therapy into practice—noting their automatic thought tendencies as they occur, and then actively practising their cognitive strategies. As the client practises interrupting old, harmful thought patterns and actively cultivating new, healthier ones, the newer patterns should become more easily activated, until eventually they become automatic themselves. In contrast, the depressive thought patterns should fade with disuse, becoming less easily activated over time.

The fact that these exercises change people's functioning has been dramatically demonstrated through neuroimaging studies, which show substantial changes to neurological function after CBT (Frewen et al., 2008). For example, one study at L'Institut Universitaire de Gériatrie de Montréal showed that, before being treated with CBT, people suffering from spider phobia showed activation in certain brain areas when viewing pictures of spiders: part of the prefrontal cortex involved with controlling emotional responses, and part of the hippocampus involved in

contextual fear memories. The activation of these two areas likely reflects the automatic reactivation of fear memories that underlie the phobia, plus the person's attempt to override the fear response. After receiving CBT, these areas were no longer active when subjects viewed spider pictures. These neuroimaging results provide us with further evidence that CBT can change a person's thought processes (Paquette et al., 2003).

Watch In the Real World: Cognitive Behavioural Therapy

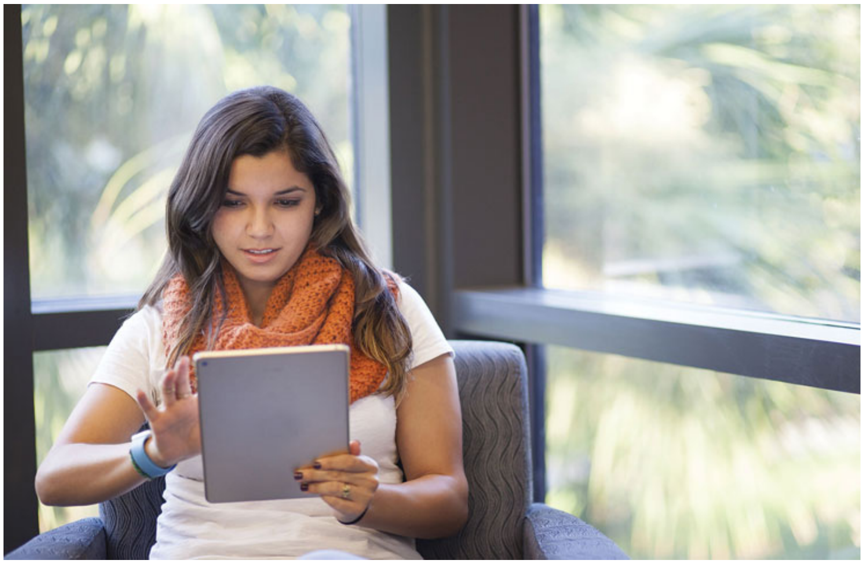
#Psych

Internet-Based Cognitive Behavioural Therapy

In Module 16.1, you read about some of the obstacles that prevent people from seeking and/or receiving treatment for psychological disorders. One major obstacle relates to location: if you live in a rural or remote area such as Northern Canada, there are very few psychologists available. One way that people are overcoming this obstacle is through the use of *internet-based cognitive behavioural therapy* (ICBT). In some

forms of ICBT, patients interact with a psychologist over the internet either through video-messaging programs such as Skype or through written messages. The patients also receive mental health “exercises” to complete that are specific to their disorder. Other forms of ICBT are entirely computer-based, with individuals going through a series of exercises (e.g., Proudfoot et al., 2004). A comparison of the two forms of ICBT found that interacting with a trained professional, even via email, leads to better outcomes (Titov et al., 2010). When done properly, ICBT can be effective for some, but not all, populations (Webb et al., 2017). In a review of 29 clinical trials, researchers found that ICBT was more effective for females than males and for people with higher levels of education than for people with less schooling. It was also more useful for treating depression than anxiety disorders, particularly if the symptoms were not severe (Rozental et al., 2019). One trend that is particularly promising given the high rates of substance abuse in remote communities is the fact that ICBT appears effective for treating adult problem drinking (Riper et al., 2018).

A number of smart phone apps have also been developed for people seeking treatment for psychological disorders. These apps are incredibly convenient, but the quality of treatment and the usefulness of the programs vary widely across apps. Interested readers should definitely look into whether the apps are monitored by trained psychologists or psychiatrists and whether users can speak to a therapist if their symptoms worsen.



Internet-based therapies are useful ways for people in remote communities to receive treatment via their computer. Ideally, these treatments would include some form of feedback from a trained psychologist. A number of phone apps have also recently been developed. Although these apps are cheap and convenient, it is worth noting that if an individual is experiencing severe distress, they should contact a psychologist rather than relying on an app.

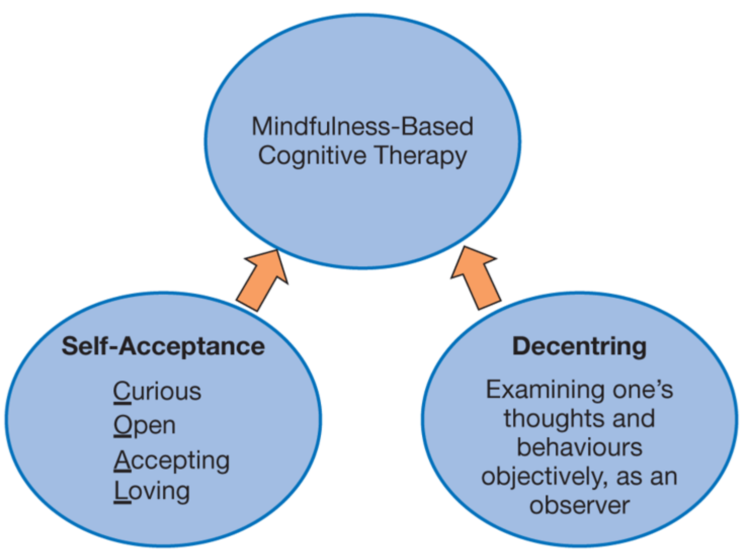
Kelsey Olson/Shutterstock

Mindfulness-Based Cognitive Therapy

Listen to the Audio

One of the biggest recent advances in therapeutic practice, spearheaded by researchers at the Centre for Addiction and Mental Health in Toronto, is **mindfulness-based cognitive therapy (MBCT)**, *a technique that combines mindfulness meditation with standard cognitive–behavioural therapy tools*. In this groundbreaking area of clinical research, East meets West and ancient meets modern, as traditional spiritual practices merge with modern psychological therapies and neuroscientific understanding (see Figure 16.4).

Figure 16.4 Mindfulness-Based Cognitive Therapy



Mindfulness-based cognitive therapy is a relatively new treatment method for some psychological disorders. It involves teaching patients elements of mindfulness while also having them complete treatment sessions with a psychologist.

Mindfulness practice and cognitive–behavioural therapy begin in somewhat similar ways—the goal of each is to get the client better acquainted with their thoughts and feelings, in the present moment of experiencing them. But after this emphasis on increased self-awareness, the two approaches differ significantly. In CBT, there is a basic orientation of *fixing themself*. The purpose of becoming aware of a person's patterns of thoughts, feelings, and behaviours is to gain greater control so that the negative patterns get replaced with more positive ones. In contrast, the practice of mindfulness involves consciously adopting an orientation of *accepting* themself fully. Strictly speaking, from a mindfulness perspective, you don't necessarily have to do anything about problematic thoughts and feelings. Instead, you make the active choice to accept them as they are, to simply observe them without reacting.

It may sound like "just watching yourself" isn't doing very much. However, it is in fact a highly active and intentional process. In order to be able to watch yourself without reacting to the thoughts and feelings that arise, you must consciously choose, again and again, to take an attitude of openness and acceptance toward yourself. A useful acronym to remember the elements of mindfulness is COAL—curious, open, accepting, and loving (Siegel, 2007). COAL is, essentially, the same attitude that parents take toward children in order to help them develop emotional security.

A second key way in which mindfulness affects a person is through the experience of **decentring**, *which occurs when a person is able to "step back" from their normal consciousness and examine themselves more objectively, as an observer*. For example, you may be dancing but then you suddenly become acutely *aware* of yourself dancing, as though you are looking at yourself from a third-person perspective. The ability to decentre is a powerful antidote to difficult thoughts and feelings. By stepping back from your own thoughts and feelings and observing them dispassionately,

you detach yourself from the damaging or troubling consequences of your thoughts (Kabat-Zinn, 1994). This can be similar to watching a young child (or politician) have a temper tantrum. Because you are not "attached" to the child's thoughts and feelings (let's assume), their anger doesn't affect you in the same way. You have some distance from it, which allows you to think more clearly and decide on the best way to respond to the situation, whereas the child is too caught up in emotions to be able to gain that cognitive control.

Practising mindfulness can lead to changes in white-matter pathways connecting brain areas related to affective and anxiety disorders, including the amygdala, hippocampus, and anterior cingulate gyrus (Laneri et al., 2016). It is also associated with a number of cognitive benefits, including improvements in attentional control and emotional regulation (Jha et al., 2007; Lutz et al., 2008). Combining these positive effects with the well-established technique of CBT could provide patients with a number of coping strategies to help them overcome their psychological disorder. Initial studies of MBCT suggest it is beneficial for social anxiety disorder and generalized anxiety (Evans et al., 2008; Piet et al., 2010), bipolar disorder (Weber et al., 2010), depression (Kingston et al., 2007), hypochondriasis (persistent fear or anxiety about having an illness) (McManus et al., 2012), and suicidal ideation (Crane & Williams, 2010). Mindfulness exercises are excellent tools for encouraging people to become more growth-oriented, and they are adaptable to both individual therapy and therapy in group settings.

Group and Family Therapies

Listen to the Audio

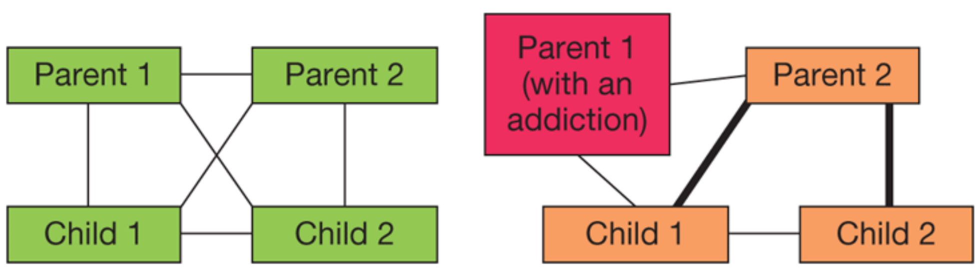
In some situations, clients may benefit from participating in group therapy sessions. Group members share their personal stories and experiences, and the bonding and support that occur in this context can be very powerful. To encourage people to open up to each other, therapists may group people together based on the issue that they are dealing with (e.g., alcohol addiction, divorce) or other similarities (e.g., age, ethnicity, gender, sexual orientation, etc.). A final, logistic advantage to group therapy is the cost, which is usually much cheaper than individual therapy. This makes group therapy accessible to a broad range of people across society.

In other situations, psychologists may conduct family therapy. This may occur if a client's difficulties stem from or are reinforced by unhealthy dynamics within the family. For example, people with schizophrenia are far less likely to have their symptoms stay in remission if their families exhibit negative patterns of communication and emotional involvement (Hooley, 2007). Thus, family therapy may be extremely effective for helping people with schizophrenia, generally in conjunction with anti-psychotic drug treatments. Family therapy may also be used to help families deal with specific family members who are highly dysfunctional in some way, such as being addicted or having poor emotional control.

Family therapists generally take a **systems approach**, *an orientation that encourages therapists to see an individual's symptoms as being influenced by*

many interacting systems. One important system is the family system, which can play a big role in the development and maintenance of psychological disorders. For example, imagine a family in which one person is emotionally abusive and controls the other family members by becoming excessively angry. A therapist taking a systems approach would see that behaviour pattern as affecting not only the individual themselves, but also the other family members (see Figure 16.5). For example, the other family members may constantly monitor that person and carefully choose their own behaviours so as to avoid making that person angry. Or the family may stop inviting other people to the house, allowing the angry person to isolate the family within the community. Or the family members may be too quick to forgive or to apologize themselves and accept the blame whenever the angry person loses their temper, rather than challenging the person and being clear about what the family will and will not tolerate. There are many different ways in which family members contribute to the maintenance of a dysfunctional pattern of behaviour, and a family systems therapist would therefore treat the individual by also working with the other family members to change the larger patterns that reinforce the problematic behaviours.

Figure 16.5 The Systems Approach to Family Therapy



Each member of a stable, functioning family unit has strong connections with the other (left figure). However, if one or more members of the family are experiencing psychological disorders, it can have an effect on the other family members and their relationships (right figure).

Evaluating Cognitive–Behavioural Therapies

Listen to the Audio

Behavioural therapies have been shown to be particularly effective at treating symptoms associated with anxiety disorders, such as obsessive-compulsive disorder and specific phobias (Chambless & Ollendick, 2001). They have also proved useful for increasing behavioural skills (e.g., social skills) and decreasing problematic behaviours (e.g., social withdrawal).

Cognitive–behavioural therapy has been quite effective in treating depression, which is not too surprising given that this method of therapy was specifically developed for this purpose (Hollon et al., 2002). A review of several clinical trials found that CBT was as effective as antidepressant medications for treating acute cases of depression (Amick et al., 2015). Neuroimaging research on people with depression showed that both antidepressant drug (SSRI) and CBT treatments affect activity in similar brain areas (Sankar & Fu, 2016), suggesting that these different approaches target similar neural processes. CBT has also been successful in treating conditions like anxiety, obesity, and eating disorders. In fact, CBT is the most effective treatment currently available for anxiety disorders, particularly over the long term, even outperforming antianxiety medications for most adult anxiety disorders (Hofmann & Smits, 2008). Furthermore, the effects last much longer than the effects of drugs, which often are effective only so long as the person remains on the medication (Hollon et al., 2006). In many cases, rather than taking an either/or approach, the best outcomes have been found by combining drug

treatments with cognitive–behavioural therapy. This has been found for several different disorders, including panic disorder with agoraphobia (Starcevic et al., 2004) and depression (McCullough, 2000).

Generally speaking, cognitive and behavioural therapies are the workhorses of psychological treatments. They are quite versatile in their applications and can help to treat a wide variety of disorders. They also take much less time (and are therefore much less expensive) than psychodynamic approaches, and have none of the undesirable side effects of drug treatments. Nevertheless, different treatments work better for different people, and it is worth remembering that for any given person, it is currently impossible to know ahead of time which treatment or combination of treatments will be most effective.

Module 16.2 Summary

Listen to the Audio

16.2a Know . . . the key terminology related to psychological therapies.

Review Module 16.2

Start Over Swap

0/17 REVIEWED · 0 MASTERED

decentring

Previous Next Got It!

16.2b Understand . . . the general approaches to conducting major types of psychological therapy.

Psychoanalysis works by uncovering hidden conflicts, whereas humanistic therapy focuses on removing conditions of worth that can

hinder a person's growth. Behavioural and cognitive therapies target dysfunctional thought and behaviour patterns, seeking to replace undesirable patterns with more functional ones that clients then practise regularly. Group and family therapies have also been developed and work with social systems that are larger than one individual.

16.2c Apply . . . your knowledge to identify major therapeutic techniques.

Apply Activity

Review Applying Therapy Styles

Imagine you are helping someone who has a phobia to find a therapist for treatment. You speak with three professionals about the approach each would take. Match their response with the corresponding school of thought.

Therapy Approach	Therapy Style
1. I would ask the individual to describe his train of thought when he encounters the feared object. Then I would ask him to explain why it is irrational to think that way, and we would try to replace his irrational thoughts with more reasonable, less anxiety-provoking beliefs.	
2. I would ask the patient to think about his earliest childhood experiences with the object, and then to speak freely about those memories at length. We would try to discover the significance of that object in his early development.	
3. We would take an active approach. One important step is to teach the client how to be calm and relaxed while gradually introducing the feared stimulus.	

Psychodynamic therapy

Start Over

16.2d Analyze . . . the pros and cons of the major types of psychological therapy.

Table 16.6 summarizes the pros and cons of the major forms of therapy discussed in this module.

Table 16.6 Pros and Cons of the Major Types of Therapy

Study the table. Then, select "Check Your Understanding" to match each type of therapy with its pros and cons.

Therapy	Pros	Cons
Insight therapies	• Can provide deep understanding of the self • Can facilitate substantial personal growth and personal transformation	• Often (but not always) involve long-term therapy, often very expensive • Can have limited application to people with serious disorders
Behavioural and cognitive therapies	• Typically time- and cost-efficient • Address immediate thoughts and behavioural problems • Address both mild and severe problems	• Do not necessarily offer deeper understanding of psychological problems • When used alone, may not be effective for some severe cases and certain disorders (e.g., schizophrenia)
Group/family therapies	• Allow individuals to empathize and relate to others with similar problems • Give family members insight into how each individual contributes to both positive and negative aspects of family life • Can change the larger social dynamics that reinforce and maintain the disorder	• Do not fully address individual issues (although group and family therapies are often used in combination with individualized therapy)

Check Your Understanding

Module 16.3 Biomedical Therapies

Listen to the Audio

VINCENT MONCORGE/LOOK AT SCIENCES/SCIENCE PHOTO LIBRARY

Learning Objectives

16.3a Know . . . the key terminology associated with biological treatments.

16.3b Understand . . . how the drugs described in this module affect brain functioning.

16.3c Understand . . . the other major medical approaches to therapy.

16.3d Apply . . . your knowledge of different therapies to different psychological conditions.

16.3e Analyze . . . whether MDMA (Ecstasy) is an effective treatment for posttraumatic stress disorder (PTSD).

May 13, 2003, was a windy and rainy Tuesday morning, but the atmosphere inside the operating theatre in a downtown Toronto hospital was anything but chilly. Neurosurgeon Andres Lozano and his neurologist collaborator, Helen Mayberg, were about to make history. Using a technique known as deep brain stimulation, Lozano, Mayberg, and their colleagues were planning to alter the activity of a very specific brain area in order to reduce the symptoms of a patient with severe depression (Mayberg et al., 2005). This area, know as the subgenual cingulate gyrus, is located just below the front of the corpus callosum. Neuroimaging research had found that its activity differed in people with depression (Mayberg et al., 1999).

The mood in the operating theatre was tense. After the first electrode stimulated the patient's brain, nothing happened. But the next electrode changed everything. When it was turned on—even at very low voltage—the patient reported feeling lighter and calmer, and said it was like spring was finally arriving (Frank, 2018). When the electricity was turned off, the feeling vanished. Mayberg and her colleagues had discovered a way to improve the negative feelings associated with depression.

However, it is important to note that not all patients showed such dramatic effects. The biology underlying psychological disorders is quite complex and no treatment is guaranteed to work for everyone. In this module, we discuss the various biomedical methods used by clinicians and researchers in their attempt to help patients with psychological disorders.

The biomedical approach to treating disorders involves using drugs, surgery, or other medical procedures in order to alter the functioning of the central nervous system to correct what is believed to be the underlying biological problem. **Psychopharmacotherapy**—*the use of drugs to manage or reduce clients' symptoms*—is by far the most frequently used biomedical option, and is often employed in conjunction with some form of psychological therapy. Other options, such as surgery or electrically stimulating the brain, are typically used only in situations where no other available treatments have succeeded. In this module, we explore and evaluate each of these biomedical treatment options and examine how they may be used in conjunction with other forms of therapy.

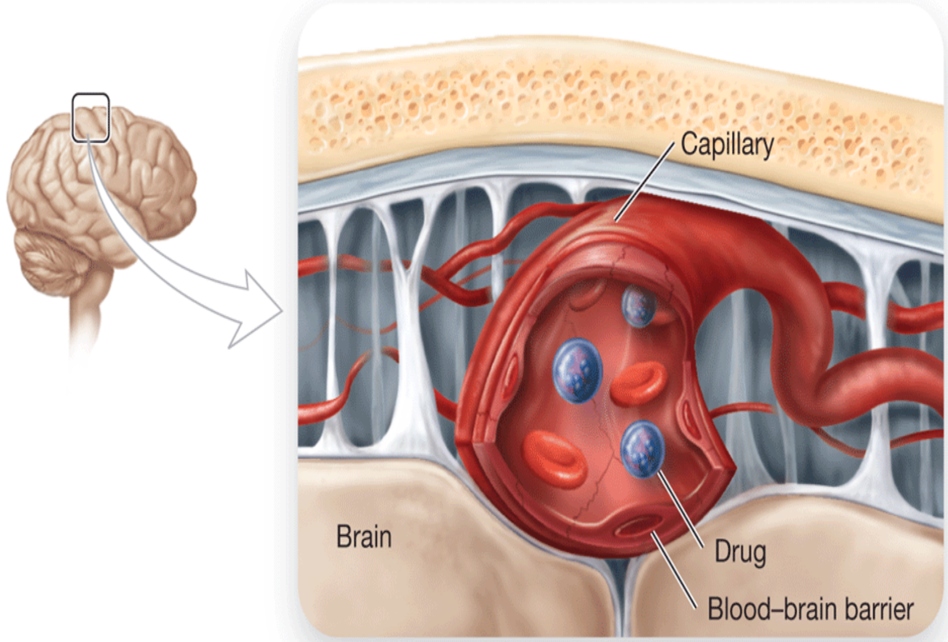
Drug Treatments

Listen to the Audio

Psychotropic drugs are *medications designed to alter psychological functioning*. Drug approaches were first predominantly used in institutional and clinical settings, generally targeting very severe cases. However, in more recent decades, psychotropic drugs have become a common treatment for many people experiencing even mild psychological problems and symptoms. This expansion has made certain psychotropic drugs, such as those used to treat depression, among the most prescribed forms of medicine (Olfson & Marcus, 2009).

Psychotropic drugs have been developed to take many different courses of action. First, all psychotropic drugs are designed to cross the **blood–brain barrier**, *a network of tightly packed cells that only allow specific types of substances to move from the bloodstream to the brain in order to protect delicate brain cells against harmful infections and other substances* (see Figure 16.6). After crossing this barrier, psychotropic drugs then affect one or more neurotransmitters. The specific neurotransmitter(s) targeted by a drug will determine which disorders will be responsive to that medication.

Figure 16.6 How Psychotropic Drugs Reach the Brain



In order to affect the brain in the desired way, psychotropic drugs must cross the blood–brain barrier, a network of densely packed cells that restrict the flow of substances between the capillaries and brain cells.

Antidepressants

Listen to the Audio

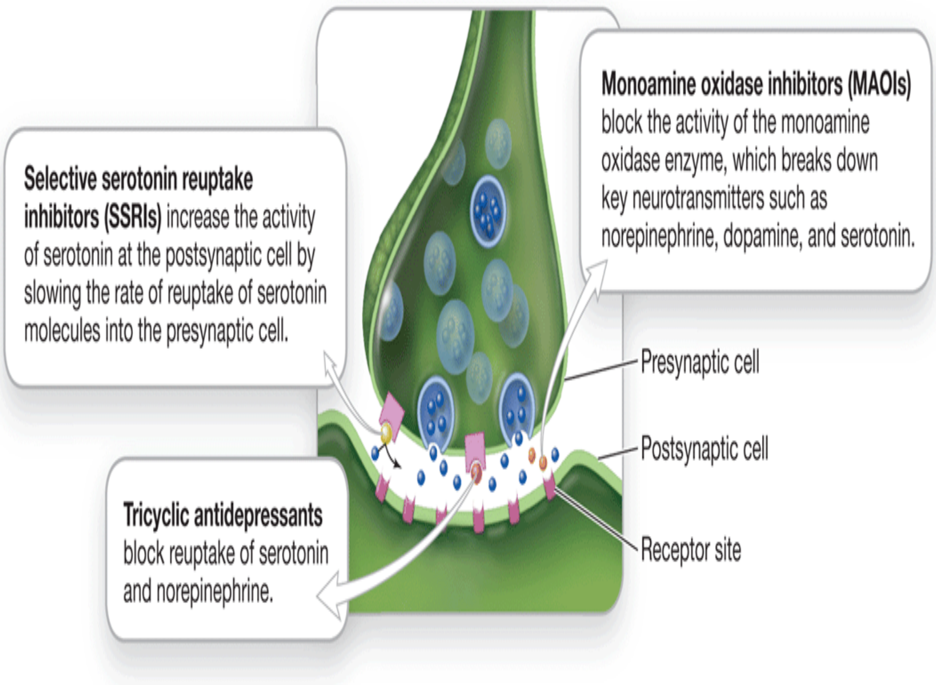
As the name suggests, **antidepressant drugs** are *medications designed to reduce symptoms of depression*. In general, antidepressant drugs target areas of the brain that, when functioning normally, are rich in monoamine neurotransmitters—serotonin, norepinephrine, and dopamine. Since multiple neurotransmitters are involved, antidepressants come in several varieties, each with its own way of altering brain chemistry (Figure 16.7).

The first type of antidepressant to be developed and widely used were **monoamine oxidase inhibitors (MAOIs)**, *which work by deactivating monoamine oxidase (MAO), an enzyme that breaks down serotonin, dopamine, and norepinephrine at the synaptic clefts of nerve cells* (see Figure 16.7). When MAO is inhibited, fewer dopamine, serotonin, and norepinephrine neurotransmitters are metabolized (i.e., broken down into smaller molecules), which in turn leaves more of them available for synaptic transmission. Although MAOIs often effectively relieve symptoms of depression, they are used less frequently than other antidepressants, in part because they can cause many side effects, some quite dangerous, especially when they interact with other medications and certain types of foods (e.g., aged cheeses, smoked meats, alcoholic beverages).

Another early type of antidepressant were the **tricyclic antidepressants**, *drugs that block the reuptake of serotonin and norepinephrine* (Figure 16.7).

Unfortunately, they also seem to cause many undesirable side effects, including nausea, weight gain, sexual dysfunction, and even seizures.

Figure 16.7 Antidepressant Effects at the Synapse



The major antidepressant drugs have different ways of increasing the transmission of neurotransmitters such as serotonin, dopamine, and norepinephrine at the synapses.

Given the severity of the side effects associated with MAOIs and tricyclic antidepressants, it should come as no surprise that both patients and physicians were eager for a new form of antidepressant to become available. In 1987, one such drug arrived: fluoxetine (also known as Prozac). Prozac is a **selective serotonin reuptake inhibitor (SSRI)**, *a class of antidepressant drugs that block the reuptake of serotonin*. Blocking reuptake means that more serotonin will remain in the synapse, thus allowing it to continue to affect the postsynaptic neurons. SSRIs alleviate some proportion of the symptoms of depression in some users and have

been the most commonly prescribed form of antidepressants since the 1980s. However, it should be noted that SSRIs do not work for everyone and that some individuals experience side effects, including changes in sleep patterns and sex drive.

SSRIs, as well as similar drugs that affect the neurotransmitter norepinephrine (SNRIs), have a number of effects on the brain, particularly on the amygdala, hippocampus, prefrontal cortex, and nucleus accumbens (a reward centre). Early neuroimaging research found that SSRIs lead to decreased activity in the amygdala, a brain area involved with intense emotional responses such as fear (Sheline et al., 2001). The activity of SSRIs in other areas is slightly more complex. In the hippocampus, antidepressants stimulate the expression of genes that control the release of *growth factors*, chemicals that promote the formation of new neurons and new synapses (Nibuya et al., 1996). In other words, SSRIs and SNRIs stimulate neurogenesis in the hippocampus; this suggests that improvements in mood and cognition might be related to neuroplasticity (Kraus et al., 2017). Importantly, output from the hippocampus influences the activity of the nucleus accumbens and prefrontal cortex. So, altering the activity of the hippocampus can lead to increased activity in "reward centres" in the brain (Willner et al., 2013); changes in these systems are likely related to patients finding everyday activities to be rewarding again. The fact that SSRIs and SNRIs can both lead to neurogenesis and neuroplasticity may explain why these drugs usually take a few weeks to affects patients' moods—it takes time for new cells to develop in the hippocampus and to become part of complex networks involving other brain areas affected by depression.

Myths in Mind

Antidepressant Drugs Are Happiness Pills

A common belief is that antidepressants are happiness in pill form—that their chemical magic can not only cause depression to disappear, but can also bring on optimism and a rush of positive emotion. In reality, antidepressant drugs can alleviate depression (in some individuals), but they do not make people happier than they were before becoming depressed.

The “happiness pill” misconception about antidepressants has led some individuals to believe that taking a high dose of antidepressants will induce a euphoric high, much like cocaine or heroin. This is also a myth. Although some people have attempted to abuse antidepressants by taking high doses (even crushing and snorting them for quicker delivery to the brain), there is no evidence that an intense rush of happiness results. In fact, as noted in the previous section of this module, SSRIs typically take a couple of weeks to work. Taking a high dose, or snorting crushed-up pills, neither magnifies their effects nor reduces the two-week waiting period before effects become evident.

In short, antidepressants are not “happiness pills” and should not be taken by people who are merely looking to boost their mood.

At this point, we have discussed both the mechanisms and the limitations of antidepressants. But this discussion has been limited to the types of medications that are prescribed by physicians. As you will see in the next section, these are not the only types of remedies available to people trying to cope with depression.

Herbal Treatments

Listen to the Audio

People often make the assumption that biomedical therapies are limited to prescription drugs. In reality, people frequently self-prescribe and administer alternative treatments for conditions such as depression. For example, many individuals take herbal treatments such as St. John's wort as an alternative to antidepressants. Although such herbal remedies often seem harmless, it is important to remember that these substances can affect neurotransmitters in the same manner as prescription drugs. St. John's wort (*Hypericum perforatum*) appears to influence several of the neurotransmitter systems that are altered by traditional antidepressant medications, including serotonin (Butterweck, 2003). However, its most prominent effect appears to be on the levels of epinephrine, a chemical associated with emotional arousal and stress responses. Several studies have shown that St. John's wort causes epinephrine receptors to *down-regulate* (move farther away from the synapse; De Marchis et al., 2006; Jakobs et al., 2013). This reduces the impact that epinephrine has on the nervous system. St. John's wort also inhibits the release of glutamate, the brain's primary excitatory neurotransmitter (Chang & Wang, 2010). As you can see, this seemingly simple herbal remedy has fairly complicated effects on the brain.

St. John's wort is a commonly used alternative to antidepressants. Researchers have found that it affects two neurotransmitters related to depression and anxiety: serotonin and epinephrine. However, St. John's wort *does* interact with other medications, so potential users should consult with their physician before taking this drug.

ArtCookStudio/Shutterstock

Clinical studies of St. John's wort suggest that this herbal medicine can have positive effects. A recent meta-analysis of 35 experiments involving 6993 patients found that St. John's wort led to reduced levels of depression when compared to placebos. Importantly, it was just as effective as traditional antidepressants, but with fewer side effects (Apaydin et al., 2016). And, in 2016, the Canadian Network for Mood and Anxiety Treatments (CANMAT) stated that St. John's wort is an effective treatment for mild to moderate depression (Ravindran et al., 2016).

That said, people should still exercise caution when using herbal remedies. Any potential users of these treatments should consult research databases such as PubMed or PsychINFO to see if psychologists or

medical researchers have investigated the treatment. They should also note that the quality of the herbal remedies is not standardized or carefully regulated by government agencies, which adds a lot of uncertainty about the effectiveness of alternative treatments (Klaus et al., 2008). Also, given that herbal remedies can influence neurotransmitters, these substances can also interact poorly with other medications that an individual is taking (Borrelli & Izzo, 2009). Therefore, it is important for healthcare providers to know all of the substances that a patient is taking.

Mood Stabilizers

Listen to the Audio

In contrast to antidepressants, which are primarily used to treat depression (unipolar disorder), **mood stabilizers** are *drugs used to prevent or reduce the severity of mood swings experienced by people with bipolar disorder*. **Lithium** was *one of the first mood stabilizers to be prescribed regularly in psychiatry, and from the 1950s to the 1980s was the standard drug treatment for depression and bipolar disorder*. Lithium, a salt compound, can be quite effective, but it can also be toxic to the kidneys and endocrine system. Today, doctors generally prefer to prescribe other drugs because they seem to be more effective and safer than lithium (Thase & Denko, 2008). For example, people with bipolar disorder now often take anticonvulsant medications such as valproate (with brand names like Depakote) or antipsychotic medications (such as the brand names Abilify or Latuda). Although these medicines can be effective in preventing manic episodes, they are also associated with side effects like weight gain, nausea, and fatigue. In rare cases, very serious side effects occur, including brain damage due to elevated levels of ammonia in the blood (Wadzinski et al., 2007).

Antianxiety Drugs

Listen to the Audio

Sometimes referred to as tranquilizers, **antianxiety drugs** *affect the activity of gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter that reduces neural activity*. These drugs are prescribed to alleviate nervousness and tension, and to prevent and reduce panic attacks. Widely prescribed examples include alprazolam (Xanax), diazepam (Valium), and lorazepam (Ativan). These drugs appear to temporarily alter the structure of GABA receptors, allowing more GABA molecules to inhibit neural activity. The effects of antianxiety drugs are relatively short-lived. They take effect within minutes of ingestion and may last for only a few hours. Given that these drugs facilitate inhibition of the nervous system, it is not surprising that their side effects include drowsiness, tiredness, and impaired attention, especially when they are taken at high doses. More serious side effects include memory impairments, depression, and decreased sex drive. These drugs also have the potential to induce abuse and withdrawal symptoms. Therefore, like other medications, antianxiety drugs should only be taken in consultation with a physician.

Working the Scientific Literacy Model

Using MDMA (Ecstasy) to Treat Posttraumatic Stress Disorder (PTSD)

Listen to the Audio

Although both talk-based therapies and medications can help many individuals with psychological disorders, there are some conditions that are resistant to many of these traditional approaches. For example, posttraumatic stress disorder (PTSD) is a severe form of anxiety disorder that can occur after someone has experienced a traumatic event. Its symptoms generally involve heightened levels of physiological arousal, increased vigilance for stimuli related to the trauma, and frequent memories of the traumatic event. The severity of these symptoms makes PTSD a challenging condition to treat. However, in the past two decades, researchers have begun innovative lines of research examining whether MDMA, a chemical associated with positive emotional responses (and the active ingredient in the drug Ecstasy), could be used to help these patients.

What do we know about using MDMA to treat PTSD?

Treatment programs that use MDMA include a number of different components. The first group of therapy sessions does not include MDMA. Rather, the patient and therapist(s) complete traditional talk-based sessions in which the patient discusses their experiences. During these appointments, the therapists and

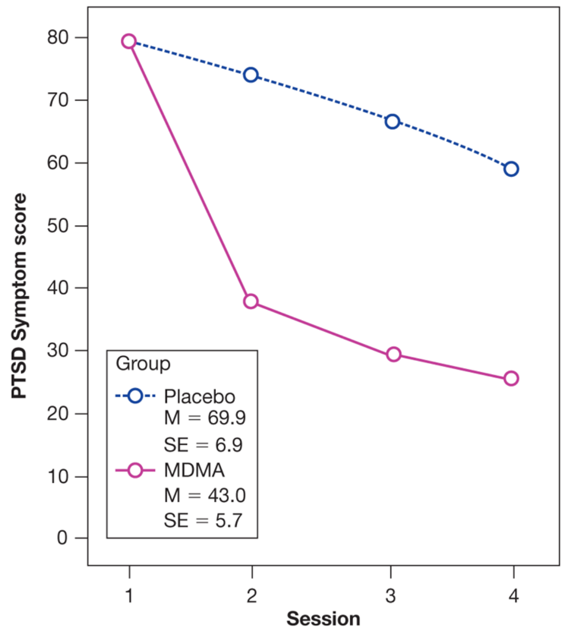
patients talk about how MDMA can affect people; the goal is to prepare the patient for the subsequent MDMA sessions. The second component of the treatment program consists of one or more day-long sessions in which the patient takes a dose of pure MDMA (i.e., not the tablets you might find at clubs). A male and female therapist then spend the day with the patient, with the aim of making the patient feel comfortable in their environment (Carhart-Harris et al., 2018). This session is non-directive, meaning that the therapists simply tell the patient to "go with the experience" rather than focusing on specific topics related to their PTSD (Sessa et al., 2019). The increase in empathy and trust that occurs when a person takes MDMA is assumed to break down social barriers for the patient, which can improve the therapeutic alliance with the therapists. The final component of this form of treatment involves multiple non-drug sessions that occur after the MDMA sessions. In these sessions, the therapists discussed the experiences that the patient had while on the drug. These experiences can include new insights the patient may have had while on MDMA as well as new topics that were broached during the session due to the improved bond the patient felt with the therapists.

What have scientific studies found about MDMA and PTSD?

The first clinical study of MDMA-assisted therapy was published in 2011 (Mithoefer et al., 2011). It consisted of 20 patients with PTSD who had not responded to previous treatments. All of the participants completed a treatment program similar to the one just described; however, half of the patients received two or three MDMA sessions while the control group received two or three sessions with a placebo drug. The results were stunning—after the final treatment session, 83% of the patients in the MDMA

group no longer met the criteria for PTSD, whereas only 25% of the placebo group showed improvement (see Figure 16.8). Subsequent studies showed similar results (Oehen et al., 2013). Importantly, a follow-up of patients in the original study found that this recovery was long-lasting (Mithoefer et al., 2013).

Figure 16.8 Clinical Effects of MDMA



The first clinical study of MDMA-assisted psychotherapy for PTSD showed great promise. Patients who received MDMA as part of their treatment were much more likely to recover from PTSD than patients who received a placebo.

Scientists have performed a number of studies that may explain these impressive clinical results. An fMRI experiment with healthy participants (i.e., not PTSD patients) found that MDMA reduced the amount of temporal-lobe activity that occurred when people recalled their worst autobiographical memory (Carhart-Harris et al., 2014). This result may be due to the fact that MDMA stimulates the release of serotonin, which in turn leads to

decreased activity in the amygdala, a brain area related to negative emotional responses (Graeff et al., 1996).

MDMA also stimulates the release of norepinephrine and dopamine. These changes lead to an increase in alertness and attentional engagement (Hysek et al., 2011), which may lead to improved concentration during therapy. Norepinephrine had an additional effect that is particularly important for PTSD patients: It can promote fear extinction (Quirk & Mueller, 2008). In PTSD, individuals learn to associate different stimuli (e.g., sirens and flashing lights) with a traumatic event (e.g., a car accident). The increased norepinephrine release that occurs when MDMA is consumed can help alter these learned associations so that the trauma-related stimuli no longer cause the patients to relive their traumatic event (Feduccia & Mithoefer, 2018; Young et al., 2015).

Can we critically evaluate this evidence?

Although MDMA treatments for PTSD show great promise, opponents of its use do raise some important concerns. The first relates to the safety of the MDMA itself. MDMA is the active ingredient in Ecstasy, a popular recreational drug (see Module 5.3). The Government of Canada has listed a number of potential dangers associated with both short-term and long-term Ecstasy use (Government of Canada, 2018). However, it is important to note that the MDMA used in clinical settings is pure, whereas Ecstasy is often contaminated with other substances. The pure form of MDMA has not been linked with any lasting impairments in physical or mental health (Ludewig et al., 2003).

A related concern is that providing vulnerable individuals with a psychedelic substance seems dangerous and could lead to addiction. Of course, the therapists are accurately aware of this issue. Patients are required to complete non-drug sessions prior

to and after the MDMA sessions so that the therapists can help them work through their MDMA experiences so that the patients think about the drug as a treatment rather than as a way to escape their pain. This strategy appears to have been successful; researchers have found that patients seldom use MDMA recreationally after they have completed therapy for PTSD (Mithoefer et al., 2013).

Why is this relevant?

PTSD is a very challenging psychological disorder to treat. Although exposure therapies can be successful for some individuals, others do not respond to this form of treatment. Therefore, having additional techniques that are available for people who do not recover after traditional treatment is important. MDMA appears to be one such option. In the past few years, an international team of researchers, including a group in Canada, has been performing clinical trials of MDMA-assisted psychotherapy. It is now in the final phase of testing before receiving approval from the U.S. Food and Drug Administration (FDA) and European Medicines Agencies (EMA). (Approval from Health Canada would likely soon follow). The goal is for licensed MDMA therapists to be able to legally use this substance in clinical settings as early as 2021. At that point, although Ecstasy would still be an illegal substance, pure MDMA would be considered to be a medicine (Sessa et al., 2019).

Antipsychotic Drugs

Listen to the Audio

Antipsychotic drugs *are generally used to treat symptoms of psychosis, including delusions, hallucinations, and severely disturbed or disorganized thought*. Antipsychotics are the common treatment for schizophrenia and are sometimes prescribed to people with severe mood disorders. There are several classes of antipsychotic drugs.

The first generation of antipsychotic medications (e.g., Thorazine, Halodol) was designed to block dopamine receptors, because symptoms of schizophrenia are related to dopamine activity in the frontal lobes and basal ganglia. However, these drugs had significant side effects, such as seizures, anxiety, nausea, and impotence. One of the more severe and often permanent side effects, **tardive dyskinesia**, is *a movement disorder involving involuntary movements and facial tics*.

Newer antipsychotic medications, known as **atypical antipsychotics** or second-generation antipsychotics, *are less likely to produce side effects, including movement disorders (like tardive dyskinesia), that commonly occur with first-generation antipsychotics*. Different atypical antipsychotics vary in their exact effects, but generally speaking they seem to work by affecting dopamine and serotonin transmission. These medications work for approximately half of the people who take them, reducing the severity of symptoms but not necessarily eliminating them altogether (Leucht et al., 2009). Unfortunately, their effects tend to weaken over time, and also come with some risk. For example, Clozapine, a very effective

antipsychotic drug, compromises the body's white blood cells. People who take Clozapine must have their blood regularly monitored to ensure that the treatment for their psychological disorder isn't compromising other systems in their body.

Review Activity

Study the table, then select the "Check Your Understanding" button to test your knowledge.

Drug	Condition
Prozac	Depression
Clozapine	Schizophrenia
Lithium	Bipolar Disorder
Xanax	Anxiety

Check Your Understanding

Evaluating Drug Therapies

Listen to the Audio

Many people believe that drugs are designed to target the root physical causes of psychological disorders, and that they should always be more effective than psychological approaches to therapy. However, these beliefs are not warranted. Although some disorders, like schizophrenia, generally require drug treatments, other disorders can be treated with drugs, therapy, or a combination of both.

Take the example of depression. The use of antidepressants has become increasingly accepted among the general public. Approximately 50% to 60% of people who take antidepressants improve within a few months—compared to 30% of people who improve after taking a placebo (Hollon et al., 2002). Interestingly, about 50% to 60% of people also improve from psychological therapy. Thus, we cannot conclude that drugs are more effective or should replace other approaches to therapy.

In other cases, such as most anxiety disorders, psychological treatments such as cognitive–behavioural therapy (Module 16.2) are generally the most effective treatment (Hofmann & Smits, 2008). A key advantage of CBT is that the effects last long after the treatment is completed (Hollon et al., 2006), whereas antianxiety medications typically are effective only as long as the client maintains the drug regimen. The superior long-term effect of CBT over drugs has been found for generalized anxiety disorder (Hofmann & Smits, 2008) and panic disorder (Barlow et al., 2000).

In many situations, a combination of treatment approaches may work best. For example, combining psychological therapy with antidepressants has been shown to be more effective in treating major depression than medication alone (Burnand et al., 2002; de Jonghe et al., 2001). A similar pattern is found for some anxiety disorders. Combining drugs with CBT is more effective for panic disorder with agoraphobia than either treatment on its own (Starcevic et al., 2004).

Even schizophrenia, which is often viewed to be an organic "brain disease," is more effectively treated by combined approaches. People with schizophrenia tend to have difficulty in self-reflecting, projecting themselves into the past and future (D'Argembeau et al., 2008), engaging in basic self-care, and integrating into regular social life. Although drugs may reduce many symptoms, additional therapy using psychological approaches has been shown to have a huge impact on reducing the likelihood of experiencing further schizophrenic episodes. Some research has shown that the likelihood of experiencing future schizophrenic episodes is affected even more strongly by social factors, such as how much negative emotion and hostility are expressed in the family, than by whether the person with schizophrenia takes their medication (Hooley & Gotlib, 2000). Clearly, even disorders that are generally viewed as predominantly biological are better understood from a biopsychosocial perspective, because they involve not only straightforward biological mechanisms, but also thoughts, feelings, behaviours, and social relationships.

Technological and Surgical Methods

Listen to the Audio

Although many drug therapies show great promise in helping patients—either alone or when combined with therapy—they do have a major limitation: The neurotransmitters that are affected by psychotropic drugs are often found in a number of different brain areas. So, although a given disorder might be primarily due to the dysfunction of a few brain areas, the activity of other neural structures will also be affected by medications (Willner et al., 2013). The challenge for researchers is to find techniques that can alter the activity of *specific* brain areas while leaving other areas alone. Fortunately, researchers have identified a number of additional biomedical treatments, ranging from direct surgical interventions to stimulation of brain areas using magnetic pulses. Today, these types of procedures tend to be quite safe and are carefully tested and scrutinized, although this has not always been the case.

Early Surgical Techniques

Listen to the Audio

You have likely heard of the **frontal lobotomy**, *surgically severing the connections between different regions of the brain*; however, you may not know the full, rather chilling, story behind it. Back as far as the 1800s, neurologists experimented with this practice in the hope of "curing" psychological problems. By the 1930s, researchers discovered that by damaging the prefrontal areas of aggressive chimpanzees, the animals would become calmer and more controllable. When Portuguese surgeon Antonio Moniz heard about this at a conference, he thought it might be useful for helping people with severe psychoses and other disorders (Boettcher & Menacho, 2017). He helped to develop the **leucotomy**, *the surgical destruction of brain tissues in the prefrontal cortex*. Drilling small holes into the skull, Moniz would typically insert a small wire loop, a leucotome, through the holes and into the brain matter; a few flips of the wrist later, the surgery was complete and the patient was left to "recover."

Moniz himself had some success with the procedure, reporting a general improvement in the symptoms of several severely depressed, anxious, or otherwise disturbed people, and recommended it as a treatment of last resort when all other methods have failed. But then the technique was popularized and turned into a veritable industry by an enterprising American surgeon, Dr. Walter Freeman. Freeman and his collaborator, Dr. James Watts, further refined the *lobotomy* (as he called the procedure) for about a decade, until he learned of a new method, developed in Italy,

for getting into the brain without having to drill holes in the skull. The secret entrance was right through the eye sockets.

Based on this insight, Freeman developed the trans-orbital lobotomy, which became known as the *icepick lobotomy*. Freeman would insert a slender metal shaft, like an icepick, in between the eyeball and eyelid, then would tap it with a hammerthrough the bony roof of the eye socket and into the brain. Then he would move it around until the frontal lobes were detached from the rest of the brain (Valenstein, 1973). He was even able to perform this brain-slicing without anesthesia, by first inducing a seizure in the patient through an electroconvulsive shock. Freeman believed the procedure to be miraculously successful. He became a passionate advocate for the lobotomy, and because he was able to perform them so quickly, often more than a dozen in a single day, he travelled around the country in his van, the "lobotomobile," lobotomizing several thousand people in total. His procedure was always controversial, seen as a miraculous cure by some and as a barbaric practice by others. It led to numerous cognitive and emotional side effects and, in some instances, ruptured blood vessels and brain damage. The mortality rate was 5% (Valenstein, 1997). Nevertheless, Freeman was a medical celebrity for a while, and toured the country teaching his technique to many doctors and psychiatrists. In total, approximately 40 000 lobotomies are believed to have been performed in the United States and thousands more in western Europe. Although the number of lobotomies performed in Canada is unknown, researchers estimate that over 1000 individuals underwent this procedure (Simmons, 1990). In fact, 763 lobotomies were performed in two Southern Ontario facilities alone (Collins, 2012).

Freeman was eventually barred from practising, although not until 1967. And despite the protestations of many people, the man who started it all, Antonio Moniz, was awarded the Nobel Prize in Medicine in 1949.

Walter Freeman performing a frontal lobotomy surgery.

Bettmann/Getty Images

Focal Lesions

Listen to the Audio

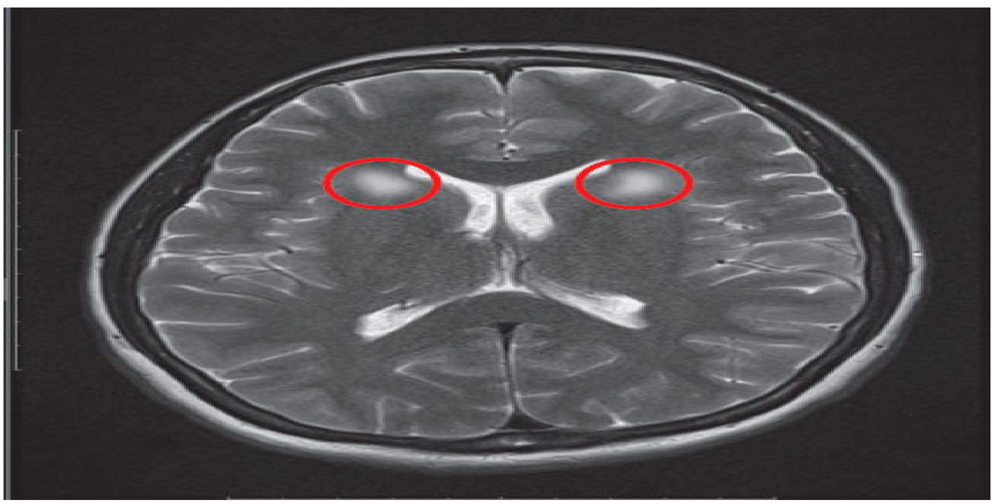
By the 1950s, the popularity of the frontal lobotomy was dwindling rapidly. The inconsistent and often very negative results of the procedure, and the effectiveness of new psychotropic medications, convinced surgeons and psychiatrists to move away from the lobotomy. Nevertheless, the basic practice of therapeutically destroying brain tissue survives to this day, although the techniques are now vastly more refined and precise.

One set of techniques involves performing **focal lesions**, *which are small areas of brain tissue that are surgically destroyed*. These brain lesions are only used in severe cases, when all other treatments have not worked to satisfaction. For example, in some cases of depression and anxiety disorders, lesion surgery has been targeted at a cluster of cells in the anterior cingulate cortex, an area that is overactive in people with these disorders (Cosgrove & Rauch, 2003; Steele et al., 2008). This procedure, which is called an anterior cingulotomy, has no more risks or side effects than do many of the drugs used to treat these disorders, and it can reduce symptoms successfully despite other treatments being ineffective.

Focal lesions have also been used to treat severe cases of obsessive-compulsive disorder. Researchers at Laval University destroyed cells in a precise region of the anterior capsule, a white-matter pathway near the basal ganglia (D’Astous et al., 2013). After recovering from the surgery,

47% of the patients reported significant improvements in their condition, which had not responded well to other treatments.

It is important to remember that focal-lesion techniques have only become possible in recent years due to the surgical precision allowed by the use of brain imaging technology, which allows surgeons to precisely target dysfunctional brain areas. Patients receive this treatment when other, less invasive options—such as medications and talk-based therapies—are ineffective. Similar restrictions are placed on other invasive, or physically demanding, procedures such as electroconvulsive therapy.



A postsurgical image of a focal brain lesion created in order to reduce the symptoms of obsessive-compulsive disorder.

springsky/Shutterstock

Electroconvulsive Therapy

Listen to the Audio

Electroconvulsive therapy (ECT) *involves passing an electrical current through the brain in order to induce a temporary seizure*. This procedure was introduced in the 1930s and has been viewed negatively for much of its history, in part because in its early days it was generally unsafe and easily abused. Many people believe that ECT causes lasting cognitive impairments, but in fact the majority of research on people who have been treated with it suggests that this is not true (Rose et al., 2003).

Over the years, ECT techniques have improved dramatically. Patients' experiences are much less negative. They are now given sedatives and muscle relaxants to reduce the discomfort they may experience and to prevent injury related to the convulsions. ECT has gone from being viewed as a torturous "shock treatment" to a relatively safe procedure, although it is still reserved for the most severe cases of disorders such as depression and bipolar disorder. The side effects are relatively mild, typically consisting of some amnesia for events occurring around the time of the treatment.

People with depression or bipolar disorder may elect to undergo electroconvulsive therapy if other treatments have not been successful.

Will & Deni McIntyre/Science Source

Why does ECT work? Neuroimaging research suggests that ECT might alter how different brain areas work together as networks. These changes are most pronounced in the frontal lobes (Beall et al., 2012; Perrin et al., 2012), particularly in areas along the midline of the brain (Argyelan et al., 2016). Animal studies of depression have found that ECT also stimulates neurogenesis in the hippocampus, an effect that mirrors antidepressant treatments (Malberg et al., 2000). One possible interpretation of this emerging literature is that ECT may alter the patient's tendency to habitually engage in negative thoughts, thereby disrupting the dysfunctional thinking patterns that are characteristic of depression. More research is needed before we will fully understand why ECT works as mysteriously well as it does.

Repetitive Transcranial Magnetic Stimulation

Listen to the Audio

Repetitive transcranial magnetic stimulation (rTMS) is *a therapeutic technique in which a focal area of the brain is exposed to a powerful magnetic field across several treatment sessions*. The magnetic field can be used to stimulate or inhibit the activity of particular brain areas. Researchers have found that stimulating the left prefrontal cortex, which is typically associated with positive emotional experiences, improves some symptoms of depression. They have also found that reducing the activity of the right prefrontal cortex, which is associated with negative emotional experiences, has the same effect (Berlim et al., 2014). Importantly, rTMS does not have immediate effects. Treatment typically involves between 10 and 25 rTMS sessions, although some accelerated programs are being tested (George et al., 2014). Patients must also return for follow-up appointments every few months.

rTMS has a number of advantages over other treatments. It does not involve anesthesia, induce a seizure, or produce cognitive impairments (Serafini et al., 2015). Additionally, rTMS may hold considerable promise for reducing symptoms of other mental disorders, such as schizophrenia (Slotema et al., 2010; Zaman et al., 2008).

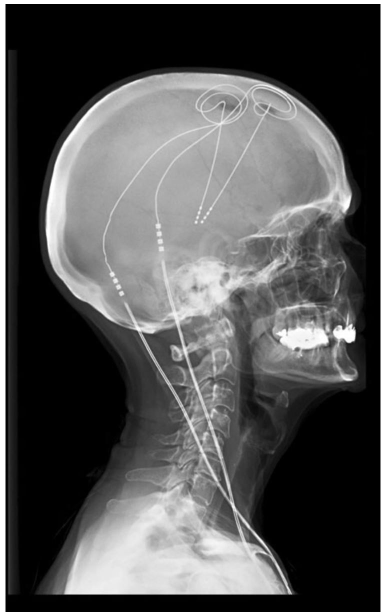
Delivering brief pulses of a strong magnetic field to specific regions of the cerebral cortex has been shown to help alleviate symptoms of severe depression and possibly other disorders.

Bonnie Weller/staff/Newscom

Deep Brain Stimulation

Listen to the Audio

The final biomedical treatment to be discussed in this module is **deep brain stimulation (DBS)**, *a technique that involves electrically stimulating specific regions of the brain*. The procedure involves inserting thin electrode-tipped wires into the brain and carefully routing them to the targeted brain regions. A small battery connected to the wires is then inserted just beneath the skin surface. Unlike many of the drugs reviewed previously, DBS produces instantaneous results, and seems to work on even severe cases of depression that have been unresponsive to other treatments. As you read at the beginning of this module, the effects can seem almost miraculous. Patients who are severely depressed report relief from their symptoms instantaneously, as soon as the electricity is applied (Mayberg et al., 2005; McNeely et al., 2008). Other researchers have shown DBS to be effective on symptoms of OCD as well (Aouizerate et al., 2009).



Deep brain stimulation involves surgically inserting a wire into the brain. Electrically stimulating very precise brain areas can sometimes lead to improvements in a number of neurological conditions and psychological disorders.

Living Art Enterprises/Science Source

Nevertheless, the technique does come with some risk, most obviously the risk of some internal bleeding and infection from the surgical insertion of the wires. DBS can also cause unintended behavioural effects. Most of these side effects are relatively benign and temporary experiences, such as spontaneous laughter and penile erections, but in some cases it may trigger troublesome states of depression or aggression (Kringelbach et al., 2007).

It is important to note that there are additional therapeutic techniques that are still in development and therefore have not been discussed in this module. Advances in gene therapies, neuroimaging, neurostimulators, and computer science will soon influence how a number of psychological disorders are treated. These innovations should provide patients with

several high-quality treatment options. The future of psychology should be exciting.

Review Activity

Please match the definition to the biomedical treatment type discussed in this section of the module.

Definition	Biomedical Treatment
This procedure involves exposing a specific brain area to a strong magnetic current; it usually involves several treatment sessions.	repetitive transcranial magnetic stimulation
This technique involves surgically destroying small sections of the brain in order to reduce the symptoms of a psychological disorder.	focal lesions
This technique involves surgically cutting the connections between different brain areas.	frontal lobotomy
This procedure involves inserting an electrode into the brain so that specific brain areas can be stimulated.	deep brain stimulation
This procedure involves passing an electrical current through the brain in order to trigger a temporary seizure.	electroconvulsive therapy

Check Your Understanding

Module 16.3 Summary

Listen to the Audio

16.3a Know . . . the key terminology associated with biological treatments.

Review Module 16.3

Start Over Swap

0/19 REVIEWED · 0 MASTERED

psychopharmacotherapy

Previous Next Got It!

16.3b Understand . . . how the drugs described in this module affect brain functioning.

Antidepressant drugs typically target monoamine neurotransmitter activity, with differing mechanisms of action (review Figure 16.7). Many

of the antipsychotic drugs on the market reduce dopamine activity in the brain. Antianxiety drugs tend to target GABA receptors and increase activity of this inhibitory neurotransmitter.

16.3c Understand . . . the other major medical approaches to therapy.

Other procedures available for treating mental illness include electroconvulsive therapy, repetitive transcranial magnetic stimulation, deep brain stimulation, and focal lesions. In some cases, particularly ECT, researchers are still unsure what aspect of the treatment produces the therapeutic results. Stimulation techniques increase the brain activity in targeted areas, whereas lesions prevent brain activity. By targeting the areas responsible for specific behaviours, thoughts, or emotions, treatments can have dramatic effects on the experience of someone with a psychological disorder.

16.3d Apply . . . your knowledge of different therapies to different psychological conditions.

Apply Activity

Please respond True or False to the following statements.

Previous Next

Correct answers to the Apply Activity above can be found in the Answer Key.

16.3e Analyze . . . whether MDMA (Ecstasy) is an effective treatment for posttraumatic stress disorder (PTSD).

Research into the effects of MDMA suggests it may be an effective treatment for many people experiencing PTSD. MDMA influences the release of serotonin, the same neurotransmitter that is affected by many antidepressant medications. The increased desire for social contact inspired by MDMA makes many patients more open to talk-based treatment, as they feel more at ease with their therapist. Importantly, the MDMA used in clinical settings is chemically pure—not the pills used by recreational drug takers, which often contain other substances—and is taken in a controlled environment. Additionally, the MDMA sessions are preceded and followed by non-drug sessions. It is the *combination* of

MDMA and talk-based therapy that helps patients who are experiencing this devasting psychological disorder.

Appendix: Experiment Simulations

Hemispheric Specialization

Experiment: Hemispheric Specialization

Weber’s Law

Experiment: Weber's Law

Ambiguous Figures

Experiment: Ambiguous Figures

Müller-Lyer Illusion

Experiment: Müller-Lyer Illusion

Latent Learning

Experiment: Latent Learning

Selective Attention

Experiment: Selective Attention

Digit Span

Experiment: Digit Span

Serial Position Effect

Experiment: Serial Position Effect

Stroop Test

Experiment: Stroop Test

Mental Rotation

Experiment: Mental Rotation

Implicit Association Test: Food

Experiment: Implicit Association Test: Food

Implicit Association Test: Cats and Dogs

Experiment: Implicit Association Test: Cats and Dogs

Implicit Association Test: Prejudice

Experiment: Implicit Association Test: Prejudice

Implicit Association Test: Sexuality

Experiment: Implicit Association Test: Sexuality

IPIP-NEO Personality Inventory

Experiment: IPIP-NEO Personality Inventory

Answer Key

Chapter 1

Module 1.1 Summary: Apply Activity

1. The ad addresses people who have already struggled with weight loss, which opens an opportunity for marketers to take advantage of emotional thinking. Fortunately, most of the ad seems to be relatively straightforward. However, the claim that users "won't have to give it a second thought" is clearly a stretch.
2. We do not have any evidence that the product works; we have only the manufacturer's claim. Until you find the evidence, you must tolerate ambiguity—you cannot say if it is effective or not.

Module 1.2 Summary: Apply Activity

1. C
2. A
3. B
4. E
5. D

Chapter 2

Module 2.1 Summary: Apply Activity

1. The problem with the instrumentation is one of reliability. One key measure of reliability in research is the degree to which a measurement provides consistent, stable responses. In this case, the recording device does not meet this criterion.

2. The problem with Dr. Nielson's happiness measure probably concerns its validity. The different observers were always in agreement on how they recorded the children's behaviour, so their measure is reliable. However, given what the second group of researchers found, it is possible that Dr. Nielson's group is actually measuring how energetic children are, rather than how happy they are. (This could also go the other way around: The researcher who was recording whether children were energetic may have been unknowingly measuring whether they were happy.)

Module 2.2 Summary: Apply Activity

1. independent; dependent

2. positive; negative

Module 2.3 Summary: Apply Activity

1. It is not really informed consent if volunteers are exposed to risks before signing a consent form. The "informed" part of informed consent means that individuals are fully informed about risks they may experience as a result of participating in a study.

2. This research design is unethical because it requires volunteers to answer all of the questions in a survey. Participants generally have the right to quit at any time, or to decline to answer any

specific questions they choose. This issue is particularly important with sensitive topics such as sexuality.

Module 2.4 Summary: Apply Activity

1. The graph appears to be negatively skewed because the large cluster of individuals is on the right with a long, sloping tail to the left.

2. The modal grade range is 90–94. That column is the tallest in the graph, making it the mode of the distribution.

3. There are nine students in the 80–89 grade range. Specifically, there is one column for the range of 80–84 and it includes four people. The next column is for the range 85–89 and it includes five. So altogether, there are nine people in the 80s.

Chapter 3

Module 3.1 Summary Apply Activity

1. Some spicy plants such as hot peppers contain capsaicin, a chemical that leads to painful sensations. This likely led early humans to avoid eating them. However, humans eventually learned that these spicy chemicals also help reduce the amount of bacteria and other pathogens in food. Evidence for this comes from the fact that areas of the world that are warmer (and thus have more bacteria-friendly climates) also tend to have the spiciest food.

2. Although modern humans typically associate alcohol with beer or wine, early humans likely associated ethanol (alcohol) with edible fruits. Microscopic fungi (yeast) can turn the sugar found in some fruits (e.g., grapes) into alcohol. So, in an effort to find these sugary fruits, early humans—and other species—would sniff around for the smell of ethanol.

Module 3.2 Summary: Apply Activity

Parkinson's disease: dopamine; Depression: serotonin; Seizures: GABA; Neuromuscular junctions: Acetylcholine

Module 3.3 Summary: Apply Activity

Visual problems: occipital lobe; Speech-production problems: Broca's area; Movement problems: cerebellum; Memory problems: hippocampus

Module 3.4 Summary: Apply Activity

1. EEG

2. PET

3. fMRI

4. ERP

Chapter 4

Module 4.1 Summary: Apply Activity

A. Correct rejection

B. Miss

C. Hit

D. False alarm

Module 4.2 Summary: Apply Activity

The pictorial depth cues include the following:

- A linear perspective (the tracks converging as they reach the horizon)
- A texture gradient (the rocks, grass, and other nearby objects can be seen in greater detail than the objects farther away)
- Height in plane (the features in the top half of the photo are perceived as far away relative to the objects in the bottom half of the photo)
- Relative size (railway ties are known to be the same size, but the ones that are closer appear larger than those that are far off)

Chapter 5

Module 5.2 Summary: Apply Activity

1. False

2. True

3. False

4. False

5. True

6. True

Chapter 6

Module 6.1 Summary: Apply Activity

1. CS = theme song, US = kiss, UR = rush of excitement, CR = rush of excitement
2. CS = test instrument (procedure), US = puff of air, UR = blinking, CR = blinking
3. CS = advertisement, US = delicious meal, UR = pleasure from the meal, CR = cravings

Module 6.2 Summary: Apply Activity

1. Negative punishment explains Bill's change in behaviour. This process is considered punishment because Bill's behaviour of cheating stopped; it is considered negative punishment because the consequence was to remove something he found reinforcing (being at school).
2. Positive reinforcement explains Ericka's pursuit of math. The personal and social rewards are stimuli that added (are positively related) to her doing math, which increased her interest in and pursuit of this subject.
3. We are negatively reinforced for closing the car doors, turning off lights, and fastening the seat belt. Each of these behaviours removes the unpleasant buzzing or dinging sound. In turn, the behaviours increase because they allow us to either avoid or escape the annoying sounds.
4. Hernan is using positive punishment. The nail and cuticle biting decrease because he introduces an unpleasant stimulus, the terrible-tasting lotion.

Module 6.3 Summary: Apply Activity

1. Teaching a children how to kick a soccer ball properly will likely involve observational learning. A teacher (you) would show the children the steps involved with kicking. If the children are having difficulty mastering each component (proper placement of the non-kicking foot, proper positioning of the kicking foot, etc.), you can use operant conditioning to shape the correct behaviours.
2. Improving efficiency in a busy office would likely involve mentoring. Efficient members of the office would likely model their behaviour for less efficient members. A system of rewards may be established to reinforce the newly learned behaviours. Remember, the different types of learning discussed in this chapter can be used together to change behaviour.
3. Improving environmentally sustainable behaviours requires that individuals have the necessary knowledge of what behaviours should be performed. This educational phase would likely involve a series of examples from universities or cities that are doing a good job being environmentally friendly. The instructor would hope that these positive behaviours would be picked up by the students; rewards may help reinforce these behaviours.

Chapter 7

Module 7.1 Summary: Apply Activity

1. Semantic Memory
2. Episodic Memory
3. Procedural Memory

Module 7.2 Summary: Apply Activity

Meenu used acronyms.

Danielle used testing effect.

Malcolm used first-letter technique.

Judith used dual coding.

Sharlynn used method of loci.

Module 7.3 Summary: Apply Activity

Malcom: biased schemas

Jennifer: imagination inflation

Rita: misinformation effect

Cleetus: misinformation effect

Luke: imagination inflation

Chapter 8

Module 8.1 Summary: Apply Activity

1. For many Canadians, prototypical sports might include hockey, football, and baseball. For much of the rest of the world, the prototypical sport is probably soccer. Sports that are not considered prototypical by many would include golf, badminton, and equestrian competitions.
2. When people respond to this category, they usually settle on prototypical items that are difficult or impossible to replace—for example, photo albums and other memorabilia, prized possessions, pets, and heirlooms.

Module 8.3 Summary: Apply Activity

1. A Morpheme
2. A phoneme and a morpheme, meaning “more than one”
3. A phoneme

Chapter 9

Module 9.2 Summary: Apply Activity

1. Fluid
2. Crystal
3. Crystal

Module 9.3 Summary: Apply Activity

1. True
2. False
3. True
4. True
5. False
6. False

Chapter 10

Module 10.3 Summary: Apply Activity

1. Jeff displays preconventional reasoning in his decision. His reasoning for engaging in the behaviour is based on whether or not he will get caught.
2. Margaret displays postconventional moral reasoning because she is not personally affected but is looking out for the well-being of innocent strangers.

Chapter 11

Module 11.3 Summary: Apply Activity

1. Ruth: Avoidance-Performance
2. Rachel: Avoidance-Mastery
3. Sydney: Approach-Mastery
4. Joe: Approach-Performance
5. Gurpreet: Approach-Performance
6. Frances: Avoidance-Mastery

Chapter 12

Module 12.2 Summary: Apply Activity

1. False. Although researchers do examine cultural variability in personality, most research has taken place on WEIRD (Western, Educated, Industrialized, Rich, Democratic) people.

2. False. Although it is possible that genetics could play a role, social and cultural factors likely account for regional variation. For example, people who grow up in rural areas are more likely to either remain there or relocate to another rural area.

3. True. For example, under some circumstances responding with a high level of anxiety would be favourable in terms of self-protection, as opposed to showing no anxiety in the face of danger.

4. True. Although brain circuits underlying specific aspects of personality are known, entire traits cannot be simplified to a single region or circuit.

5. False. Research has shown that animals also have stable, individual differences and even the Big Five can be applied to the behaviour of some species.

Chapter 15

Module 15.1 Summary: Apply Activity

1. Not Guilty. Tyson committed his crime while he was experiencing hallucinations associated with a psychological disorder. Therefore, at the time of the crime, he could not distinguish between “right” and “wrong.”

2. Guilty. Although Rick likely experienced a psychological disorder, this illness would not have impaired his ability to understand that

committing an act of violence is wrong.

Module 15.2 Summary: Apply Activity

1. Histrionic personality disorder
2. Obsessive-compulsive personality disorder
3. Borderline personality disorder
4. Antisocial personality disorder
5. Narcissistic personality disorder
6. Schizotypal personality disorder

Module 15.3 Summary: Apply Activity

1. Obsessive-compulsive disorder
2. Bipolar disorder
3. Specific phobia
4. Major depression
5. Generalized anxiety disorder

Module 15.4 Summary: Apply Activity

1. Negative
2. Positive
3. Negative
4. Positive

Chapter 16

Module 16.2 Summary: Apply Activity

1. B: Cognitive-behavioral therapy, because it is aimed at addressing irrational thought patterns and cognitive restructuring

2. C: Psychodynamic therapy, because the emphasis is on gaining insight into early childhood experiences

3. E: Behavioural therapy, because the focus is on modifying observable behaviour patterns

Module 16.3 Summary: Apply Activity

1. False

2. True

3. False

4. False

5. True

6. False

7. True

References

AbdelMalik, P., Husted, J., Chow, E. W., & Bassett, A. S. (2003). Childhood head injury and expression of schizophrenia and multiply affected families. *Archives of General Psychiatry*, *60*, 231–236.

Abé, C., Johansson, E., Allzén, E., & Savic, I. (2014). Sexual orientation related differences in cortical thickness in male individuals. *PLoS ONE*, *9*, e114721.

Abematsu, M., Kagawa, T., Fukuda, S., Inoue, T., Takebayashi, H., Komiya, S., & Taga, T. (2006). Basic fibroblast growth factor endows dorsal telencephalic neural progenitors with the ability to differentiate into oligodendrocytes but not gamma-aminobutyric acidergic neurons. *Journal of Neuroscience Research*, *83*, 731–743.

Abouguendia, M., & Noels, K. A. (2001). General and acculturation-related daily hassles and psychological adjustment in first- and second-generation South Asian immigrants to Canada. *International Journal of Psychology*, *36*, 163–173.

Abraham, W. (2006). Memory maintenance: The changing nature of neural mechanisms. *Current Directions in Psychological Science*, *15*, 5–8.

Abramowitz, E., Barak, Y., Ben-Avi, I., & Knobler, H. (2008). Hypnotherapy in the treatment of chronic combat-related PTSD patients suffering from insomnia: A randomized, zolpidem-controlled clinical trial. *International Journal of Clinical and Experimental Hypnosis*, *56*, 270–280.

Abramson, L. Y., Seligman, M. E., & Teasdale, J. D. (1978). Learned helplessness in humans: Critique and reformulation. *Journal of Abnormal Psychology*, *87*, 49–74.

Academy of Neurology Quality Standards Subcommittee. (1995). Practice parameters for determining brain death in adults. *Neurology*, *45*, 1012–1014.

Acevedo-Garcia, D., Osypuk, T. L., McArdle, N., & Williams, D. R. (2008). Towards a policy relevant analysis of geographic and racial/ethnic disparities in child health. *Health Affairs*, *27*, 321–333.

Adair, G. (1984). The Hawthorne effect: A reconsideration of the methodological artifact. *Journal of Applied Psychology*, *69*, 334–345.

Adam, T. C., & Epel, E. S. (2007). Stress, eating, and the reward system. *Physiology and Behavior*, *91*, 449–458.

Adams, H. E., Wright, L. W., & Lohr, B. A. (1996). Is homophobia associated with homosexual arousal? *Journal of Abnormal Psychology*, *105*, 440–445.

Adelstein, J. S., Shehzad, Z., Mennes, M., DeYoung, C. G., Zuo, X.-N., et al. (2011). Personality is reflected in the brain's intrinsic functional architecture. *PLoS ONE*, *6*, e27633.

Adorno, T. W., Frenkel-Brunswik, E., Levinson, D. J., & Sanford, R. N. (1950). *The authoritarian personality*. New York: Harper and Row.

Aggleton, J. P., & Waskett, L. (1999). The ability of odours to serve as state-dependent cues for real-world memories: Can Viking smells aid the recall of Viking experiences? *British Journal of Psychiatry*, *90*, 1–7.

Ahamed, Y., Macdonald, H., Reed, K., Naylor, P.J., Liu-Ambrose, T., & McKay, H. (2007). School-based physical activity does not compromise children's academic performance. *Medicine and Science in Sports and Exercise*, *39*, 371–376.

Ahlfinger, N. R., & Esser, J. K. (2001). Testing the groupthink model: Effects of promotional leadership and conformity predisposition. *Social Behavior and Personality*, *29*, 31–41.

Ainsworth, M. D. S. (1978). The development of infant–mother attachment. In B. M. Caldwell & H. N. Ricciuti (Eds.), *Review of child development research* (Vol. 3, pp. 1–94). Chicago: University of Chicago Press.

Ajonijebu, D. C., Abboussi, O., Russell, V. A., Mabandla, M. V., & Daniels, W. M. U. (2017). Epigenetics: a link between addiction and

social environment. *Cellular and Molecular Life Sciences*, *74*, 2735–2747.

Albert, S. (1977). Temporal comparison theory. *Psychological Review*, *84*, 485–503.

Aldous, J., & Ganey, R. F. (1999). Family life and the pursuit of happiness: The influence of gender and race. *Journal of Family Issues*, *20*, 155–180.

Alicke, M. D., & Olesya, G. (2005). The better-than-average effect. In M. D. Alicke, D. A. Dunning, and J. I. Krueger (Eds). *The self in social judgment* (pp. 85–106). New York: Psychology Press.

Alladin, A. (2012). Cognitive hypnotherapy for major depressive disorder. *American Journal of Clinical Hypnosis*, *54*, 275–293.

Alladin, A., & Alibhai, A. (2007). Cognitive hypnotherapy for depression: An empirical investigation. *International Journal of Clinical and Experimental Hypnosis*, *55*, 147–166.

Allen, J. S., Bruss, J., Brown, C. K., & Damasio, H. (2005). Normal neuroanatomical variation due to age: The major lobes and a parcellation of the temporal region. *Neurobiology of Aging*, *26*, 1245–1260.

Allen, S. W., Norman, G. R., & Brooks, L. R. (1992). Experimental studies of learning dermatologic diagnosis: The impact of examples.

Research Basic to Medical Education, *4*, 35–44.

Allport, G. W. (1954). *The nature of prejudice*. Cambridge, MA: Perseus Books.

Allport, G. W. (1955). *Becoming: Basic considerations for a psychology of personality*. New Haven, CT: Yale University Press.

Allport, G., & Odbert, H. W. (1936). Trait names: A psycholexical study. *Psychological Monographs*, *47*, 211.

Altemeyer, B. (1996). *The authoritarian specter*. Cambridge, MA: Harvard University Press.

Amaral, D. G., Capitanio, J. P., Jourdain, M., Mason, W. A., Mendoza, S. P., & Prather, M. (2003). The amygdala: Is it an essential component of the neural network for social cognition? *Neuropsychologia*, *41*, 235–240.

Amat, J., Baratta, M. V., Paul, E., Bland, S. T., Watkins, L. R., & Maier, S. F. (2005). Medial prefrontal cortex determines how stressor controllability affects behavior and dorsal raphe nucleus. *Nature Neuroscience*, *8*, 365–371.

Amato, P. R. (2001). Children of divorce in the 1990s: An update of the Amato and Keith (1991) meta-analysis. *Journal of Family Psychology*, *15*, 355–370.

Ambady, N., & Rosenthal, R. (1993). Half a minute: Predicting teacher evaluations from thin slices of nonverbal behavior and physical attractiveness. *Journal of Personality and Social Psychology*, *64*, 431–441.

American Academy of Pediatrics. (1999). Media education. *Pediatrics*, *104*, 341–342.

American College Health. (2016). American College Health Association national college health assessment II: Canadian reference group data report. Spring 2016. American College Health Association: Hanover, MD. Retrieved from www.acha.org/documents/ncha/NCHA-II%20SPRING%202016%20CANADIAN%20REFERENCE%20GROUP%20DATA%20REPORT.pdf

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

American Psychological Association. (2009). Task force on evidence-based practice. Retrieved from www.apa.org/practice/ebp.html

American Psychological Association. (2010). Psychology and global climate change: Addressing a multifaceted phenomenon and set of challenges. Retrieved from www.apa.org/science/about/publications/climate-change.aspx

American Psychological Association. (2011). Suicide warning signs. Retrieved from www.apa.org/topics/suicide/signs.aspx

Amick, H. R., Gaynes, B. N., Asher, G. N., Coker-Schwimmer, E., Gaylord, S., ... Lohr, K. N. (2015). Comparative benefits and harms of second generation antidepressants and cognitive behavioral therapies in initial treatment of major depressive disorder: systematic review and meta-analysis. *British Medical Journal*, *351*, h6019.

An, K., Kobayashi, S., Tanaka, K., Kaneda, H., Su-gibayashi, M., & Okazaki, J. (1998). Dissociative identity disorder and childhood trauma in Japan. *Psychiatry and Clinical Neurosciences*, *52*, 111–114.

Anastasi, A., & Urbina, S. (1996). *Psychological testing*. New York: Prentice Hall.

Anderson, B. & Coletto, D. (2017, April 29). Canadian news media and "fake news" under a microscope. *Abacus Data*. Retrieved from https://abacusdata.ca/canadian-news-media-and-fake-news-under-a-microscope/

Anderson, B., & Harvey, T. (1996). Alterations in cortical thickness and neuronal density in the frontal cortex of Albert Einstein. *Neuroscience Letters*, *210*, 161–164.

Anderson, C. A., Berkowitz, L., Donnerstein, E., Huesmann, L. R., Johnson, J. D., Linz, D., ... Wartella, E. (2003). The influence of

media violence on youth. *Psychological Science in the Public Interest*, *4*, 81–110.

Anderson, C. A., Gentile, D. A., & Buckley, K. E. (2007). *Violent video game effects on children and adolescents*. Oxford, U.K.: Oxford University Press.

Anderson, C. A., Shibuya, A., Ihori, N., Swing, E. L., Bushman, B. J., Sakamoto, A., et al. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in Eastern and Western countries: A meta-analytic review. *Psychological Bulletin*, *136*, 151–173.

Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., & Wright, J. C. (2001). Early childhood television viewing and adolescent behavior. *Monographs of the Society for Research in Child Development*, *68* (1, Serial No. 264).

Anderson, L., Lewis, G., Araya, R., Elgie, R., Harrison, G., ... & Williams, C. (2005). Self-help books for depression: How can practitioners and patients make the right choice? *British Journal of General Practice*, *55*, 387–392.

Andreasen, N. C., Arndt, S., Alliger, R., Miller, D., & Flaum, M. (1995). Symptoms of schizophrenia: Methods, meaning, and mechanisms. *Archives of General Psychiatry*, *52*, 341–351.

Andres, M., Pelgrims, B., Michaux, N., Oliver, E., & Pesenti, M. (2011). Role of distinct parietal areas in arithmetic: An fMRI-guided TMS

study. *NeuroImage*, *54*, 3048–3056.

Angus Reid Institute (2015, March 26). Religion and faith in Canada today: strong belief, ambivalence and rejection define our views. Retrieved from http://angusreid.org/faith-in-canada/

Ano, G. G., & Vasconcelles, E. B. (2005). Religious coping and psychological adjustment to stress: A meta-analysis. *Journal of Clinical Psychology*, *61*, 461–480.

Anton, M. E., Baskin-Sommers, A. R., Vitale, J. E., Curtin, J. J., & Newman, J. P. (2013). Differential effects of psychopathy and antisocial personality disorder symptoms on cognitive and fear processing in female offenders. *Cognitive, Affective, and Behavioral Neuroscience*, *12*, 761–776.

Antoni, M., & Lutgendorf, S. (2007). Psychosocial factors and disease progression in cancer. *Current Directions in Psychological Science*, *16*, 42–46.

Antoni, M., Lutgendorf, S., Cole, S., Dhabhar, F., Sephton, S., McDonald, P., et al. (2006). The influence of biobehavioral factors on tumor biology, pathways and mechanisms. *Nature Reviews Cancer*, *6*, 240–248.

Antoni, M., Schneiderman, N., & Penedo, F. (2007). Behavioral interventions and psychoneuroimmunology. In R. Ader, R. Glaser, N. Cohen, & M. Irwin (Eds.), *Psychoneuroimmunology* (4th ed., pp. 615–703). New York: Academic Press.

Aouizerate, B., Cuny, E., Bardinct, E., Yelnik, J., Martin-Guehl, C., Rotge, J. Y., et al. (2009). Distinct striatal targets in treating obsessive-compulsive disorder and major depression. *Journal of Neurosurgery*, *111*, 775–779.

Apaydin, E. A., Maher, A. R., Shanman, R., Booth, M. S., Miles, J. N. ... Hempel, S. (2016). A systematic review of St. John's wort for major depressive disorder. *Systematic Reviews*, *5*, 148.

Appel, H., Gerlach, A. L., & Crusius, J. (2016). The interplay between Facebook use, social comparison, envy, and depression. *Current Opinion in Psychology*, *9*, 44–49.

Arendt, J. (2009). Managing jet lag: Some of the problems and possible new solutions. *Sleep Medicine Reviews*, *13*, 249–256.

Arguin, M., Bub, D., & Dudek, G. (1996). Shape integration for visual object recognition and its implication in category-specific visual agnosia. *Visual Cognition*, *3*, 221–275.

Argyelan, M., Lencz, T., Kaliora, S., Sarpal, D. K. Weissman, N., ... Petrides, G. (2016). Subgenual cingulate cortical activity predicts the efficacy of electroconvulsive therapy. *Translational Psychiatry*, *6*, e789.

Armstrong, H. L., & Reissing, E. D. (2015). Women's motivations to have sex in casual and committed relationships with male and female partners. *Archives of Sexual Behavior*, *44*, 921–934.

Arnett, J. (1992). Reckless behavior in adolescence: A developmental perspective. *Developmental Review*, *12*, 339–373.

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, *55*, 469–480.

Aron, A., Fisher, H., Mashek, D. J., Strong, G., Li, H., & Brown, L. L. (2005). Reward, motivation, and emotion systems associated with early-stage intense romantic love. *Journal of Neurophysiology*, *94*, 327–337.

Asch, S. E. (1951). Effects of group pressure upon the modification and distortion of judgments. In H. Guetzkow (Ed.), *Groups, leadership and men: Research in human relations* (pp. 177–190). Oxford, UK: Carnegie Press.

Asch, S. E. (1955). Opinions and social pressure. *Scientific American*, *193*, 31–35.

Asch, S. E. (1956). Studies of independence and conformity: A minority of one against a unanimous majority. *Psychological Monographs*, *70* (9, No. 416).

Aschoff, J. (1965). Circadian rhythms in man. *Science*, *148*, 1427–1432.

Aschoff, J., & Wever, R. (1962). Spontanperidik des menschen bei ausschluss aller zeitgeber. *Naturwissenschaftern*, *49*, 337–342.

Aschoff, J., Gerecke, U., & Wever, R. (1967). Desynchronization of human circadian rhythms. *Japanese Journal of Physiology*, *17*, 450–457.

Aserinsky, E., & Kleitman, N. (1953). Regularly occurring periods of eye motility, and concomitant phenomena, during sleep. *Science*, *118*, 273–274.

Ashby, F. G., & Rosedahl, L. (2017). A neural interpretation of exemplar theory. *Psychological Review*, *124*, 472–482.

Ashby, F. G., Isen, A. M., & Turken, A. U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review*, *106*, 529–550.

Ashtari, M., Cervellione, K., Cottone, J., Ardekani, B. A., & Kumra, S. (2009). Diffusion abnormalities in adolescents and young adults with a history of heavy cannabis use. *Journal of Psychiatry Research*, *43*, 189–204.

Ashton, M. C., & Lee, K. (2007). Empirical, theoretical, and practical advantages of the HEXACO model of personality structure. *Personality and Social Psychology Review*, *11*, 150–166.

Ashton, M. C., & Lee, K. (2008). The HEXACO Model of Personality Structure and the importance of the H factor. *Social and Personality Psychology Compass*, *2*, 1952–1962.

Aslin, R. N. (2007). What's in a look? *Developmental Science*, *10*, 48–53.

Assor, A., Roth, G., & Deci, E. L. (2004). The emotional costs of parents' conditional regard: A self-determination theory analysis. *Journal of Personality*, *72*, 47–88.

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposal system and its control processes. In K.W. Spence and J.T. Spence (Eds.), *The psychology of learning and motivation 8*. London, UK: Academic Press.

Atran, S., Estin, P., Coley, J., & Medin, D. (1997). generic species and basic levels: Essence and appearance in folk biology. *Journal of Ethnobiology*, *17*, 17–43.

Auer, R., Vittinghoff, E., Yaffe, K., Kertesz, S. G., Levine, D. A., Sidney, S., ... Pletcher, M. J. (2016). Association between marijuana exposure and cognitive function in middle age: The coronary artery risk development in young adults (CARDIA) study. *Circulation*, *129*(Suppl_1), AP131.

Ausubel, D. P. (1966). Early versus delayed review in meaningful learning. *Psychology in the Schools*, *3*, 195–198.

Avena, N. M., Rada, P., & Hoebel, B. G. (2008). Evidence for sugar addiction: Behavioral and neurochemical effects of intermittent, excessive sugar intake. *Neuroscience and Biobehavioral Reviews*, *32*, 20–39.

Avolio, B. J., & Waldman, D. A. (1994). Variations in cognitive, perceptual, and psychomotor abilities across the working life span: Examining the effects of race, sex, experience, education, and occupational type. *Psychology and Aging*, *9*, 430–442.

Avramopoulos, D., Stefanis, N. C., Hantoumi, I., Smyrnis, N., Evdokimidis, I., & Stefanis, C.N., (2002). Higher scores of self reported schizotypy in healthy young males carrying the COMT high activity allele. *Molecular Psychiatry, 7*, 706–711.

Awh, E., Barton, B., & Vogel, E. K. (2007). Visual working memory represents a fixed number of items, regardless of complexity. *Psychological Science*, *18*, 622–628.

Babiak, P., & Hare, R. D. (2006). *Snakes in suits: When psychopaths go to work.* New York: Regan Books/Harper Collins Publishers.

Babyak, M. A., Blumenthal, J. A., Herman, S., Khatri, P., Doraiswamy, P. M., ... Krishnan, K. R. (2000). Exercise treatment for major depression: Maintenance of therapeutic benefit at 10 months. *Psychosomatic Medicine*, *62*, 633–638.

Bachman, J. G., Wadsworth, K. N., O'Malley, P. M., & Johnston, L. D. (1997). *Smoking, drinking, and drug use in young adulthood: The*

impacts of new freedoms and new responsibilities. Hillsdale, NJ: Lawrence Erlbaum Associates.

Bacon, J. G., Scheltema, K. E., & Robinson, B. E. (2001). Fat phobia scale revisited. The short form. *International Journal of Obesity*, *25*, 252–257.

Baddeley, A. (2001). Is working memory still working? *American Psychologist*, *56*, 851–864.

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 8, pp. 47–89). New York: Academic Press.

Baddeley, A. D., Thomson, N., & Buchanan, M. (1975). Word length and the structure of short-term memory. *Journal of Verbal Learning & Verbal Behavior*, *14*, 575–589.

Badham, S. P., Sanborn, A. N., & Maylor, E. A. (2017). Deficits in category learning in older adults: Rule-based versus clustering accounts. *Psychology and Aging*, *32*, 473–488.

Badman, M. K., & Flier, J. S. (2005). The gut and energy balance: Visceral allies in the obesity wars. *Science*, *307*, 1909–1914.

Bae, H. T., Sebastiani, P., Sun, J. X., Andersen, S. L., Daw, E. W., ... Perls, T. T. (2013). Genome-wide association study of personality traits in the Long Life Family Study. *Frontiers in Genetics*, *4*, 65.

Baer, R. A., Carmody, J., & Hunsinger, M. (2012). Weekly change in mindfulness and perceived stress in a mindfulness-based stress reduction program. *Journal of Clinical Psychology*, *68*, 755–765.

Bahrick, H. (1984). Semantic memory content in permastore: Fifty years of memory for Spanish learned in school. *Journal of Experimental Psychology: General*, *113*, 1–29.

Bahrick, L. E., & Watson, J. S. (1985). Detection of intermodal proprioceptive–visual contingency as a potential basis of self-perception in infancy. *Developmental Psychology*, *21*, 963–973.

Bailenson, J. N., Shum, M. S., Atran, S., Medin, D., & Coley, J. D. (2002). A bird's eye view: Biological categorization and reasoning within and across cultures. *Cognition*, *84*, 1–53.

Bailey, J. M., & Pillard, R. C. (1995). Genetics of human sexual orientation. *Annual Review of Sex Research*, *6*, 126–150.

Bailey, J. M., Dunne, M. P., & Martin, N. G. (2000). Genetic and environmental influences on sexual orientation and its correlates in an Australian twin sample. *Journal of Personality and Social Psychology*, *78*, 524–536.

Bailey, J. M., Pillard, R. C., Neale, M. C., & Agyei, Y. (1993). Heritable factors influence sexual orientation in women. *Archives of General Psychiatry*, *50*, 217–223.

Baird, B., Smallwood, J., & Schooler, J.W. (2011). Back to the future: autobiographical planning and the functionality of mind-wandering. *Consciousness and Cognition*, *20*, 1604–1611.

Baker, J. R., Bezance, J. B., Zellaby, E., & Aggleton, J. P. (2004). Chewing gum can produce context-dependent effects upon memory. *Appetite*, *43*, 207–210.

Balch, W., Myers, D., & Papotto, C. (1999). Dimensions of mood in mood-dependent memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*, 70–83.

Balk, G. (2018, June 28). "Mean world syndrome": In some Seattle neighborhoods, fear of crime exceeds reality. *The Seattle Times*. Retrieved from https://www.seattletimes.com/seattle-news/data/mean-world-syndrome-in-some-seattle-neighborhoods-fear-of-crime-exceeds-reality/

Ball, K., & Lee, C. (2002). Psychological stress, coping, and symptoms of disordered eating in a community sample of young Australian women. *International Journal of Eating Disorders*, *31*, 71–81.

Ball, K., & Owsley, C. (1993). The useful field of view test: a new technique for evaluating age-related declines in visual function. *Journal of the American Optometric Association*, *64*, 71–79.

Ball, K., & Owsley, C. (2000). Increasing mobility and reducing accidents of older drivers. In K.W. Schaie and M. Pietrucha (Eds.), *Mobility and transportation in the elderly* (pp. 213–251). New York: Springer.

Balter, L. J. T., Good, K. P., & Barrett, S. P. (2015). Smoking cue reactivity in current smokers, former smokers and never smokers. *Addictive Behaviors*, *45*, 26–29.

Baltes, P. B., & Lindenberger, U. (1997). Emergence of a powerful connection between sensory and cognitive functions across the adult life span: A new window to the study of cognitive aging? *Psychology and Aging*, *12*, 12–21.

Bandelow, B., & Wedekind, D. (2015). Possible role of a dysregulation of the endogenous opioid system in antisocial personality disorder. *Human Psychopharmacology*, *30*, 393–415.

Bandura, A. (1973). *Aggression: A social learning analysis*. Engelwood Cliffs, NJ: Prentice-Hall.

Bandura, A. (1978). *Social learning theory*. Englewood Cliffs, NJ: Prentice Hall.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman.

Bandura, A., & Walters, R. H. (1963). *Social learning and personality development*. New York: Holt, Rinehart, and Winston.

Bandura, A., Ross, D., & Ross, S. A. (1961). Transmission of aggression through imitation of aggressive models. *Journal of Abnormal and*

Social Psychology, *63*, 575–582.

Bandura, A., Ross, D., & Ross, S. A. (1963). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology*, *66*, 3–11.

Banse, R., Seise, J., & Zerbes, N. (2001). Implicit attitudes toward homosexuality: Reliability, validity, and controllability of the IAT. *Zeitschrift fur Experimentelle Psychologie*, *48*, 145–160.

Banuazizi, A., & Movahedi, S. (1975). Interpersonal dynamics in a simulated prison: A methodological analysis. *American Psychologist*, *30*(2), 152–160.

Bar-Haim, Y., Lamy, D., Pergamin, L., Bakermans-Kranenburg, M. J., & van Ijzendoorn, M. H. (2007). Threat-related attentional bias in anxious and nonanxious individuals: A meta-analytic study. *Psychological Bulletin*, *133*, 1–24.

Barabasz, M. (2007). Efficacy of hypnotherapy in the treatment of eating disorders. *International Journal of Clinical and Experimental Hypnosis*, *55*, 318–335.

Barbanoj, M. J., Riba, J., Clos, S., Giménez, S., Grasa, E., & Romero, S. (2008). Daytime Ayahuasca administration modulates REM and slow-wave sleep in healthy volunteers. *Psychopharmacology (Berl.)*, *196*, 315–326.

Barber, K. (Ed.). (2004). Bird. *Canadian Oxford dictionary*. 2nd ed. Toronto: Oxford University Press.

Barbopoulos, A., & Clark, J. M. (2003). Practising psychology in rural settings: Issues and guidelines. *Canadian Psychology*, *44*, 410–424.

Bard, K. A., Todd, B., Bernier, C., Love, J., & Leavens, D. A. (2006). Self-awareness in human and chimpanzee infants: What is measured and what is meant by the mirror-and-mark test? *Infancy*, *9*, 185–213.

Barger, L. K., Cade, B. E., Ayas, N. Y., Cronin, J. W., Rosner, B., Speizer, F. E., & Czeisler, C. A. (2005). Extended work shifts and the risk of motor vehicle crashes among interns. *The New England Journal of Medicine*, *352*, 125–134.

Barger, S. D., & Sydeman, S. J. (2005). Does generalized anxiety disorder predict coronary heart disease risk factors independently of major depressive disorder? *Journal of Affective Disorders*, *88*, 87–91.

Bargh, J. A. (1999). The cognitive monster. In S. Chaiken & Y. Trope (Eds.), *Dual process theories in social psychology* (pp. 361–382). New York: Guilford Press.

Barkley, R. A. (1998). *Attention-deficit/hyperactivity disorder*. Chicago: Guilford Press.

Barlow, D. H., Gorman, J. M., Shear, M. K., & Woods, S. W. (2000). Cognitive-behavioral therapy, imipramine, or their combination for panic disorder: A randomized controlled trial. *Journal of the American Medical Association*, *283*, 2529–2536.

Barnea-Goraly, N., Menon, V., Eckert, M., Tamm, L., Bammer, R., Karchemskiy, A., et al. (2005). White matter development during childhood and adolescence: A cross-sectional diffusion tensor imaging study. *Cerebral Cortex*, *15*, 1848–1854.

Barnes, C., & Wagner, D. (2009). Changing to Daylight Saving Time cuts into sleep and increases workplace injuries. *Journal of Applied Psychology*, *94*, 1305–1317.

Barolo, R., Prado, L., & Merchant, H. (2014). Information processing in the primate basal ganglia during sensory guided and internally driven rhythmic tapping. *Journal of Neuroscience*, *34*, 3910–3923.

Baron-Cohen, S., Burt, L., Smith-Laittan, F., Harrison, J., & Bolton, P. (1996). Synaesthesia: Prevalence and familiality. *Perception*, *25*, 1073–1079.

Barr, C. E., Mednick, S. A., & Munk-Jorgensen, P. (1990). Exposure to influenza epidemics during gestation and adult schizophrenia. A 40-year study. *Archives of General Psychiatry*, *47*, 869–874.

Barr, R. (2010). Transfer of learning between 2D and 3D sources during infancy: Informing theory and practice. *Developmental Review*, *30*, 128–154.

Barr, R., & Hayne, H. (1999). Developmental changes in imitation from television during infancy. *Child Development*, *70*, 1067–1081.

Barratt, E. L., & Davis, N. J. (2015). Autonomous Sensory Meridian Response (ASMR): A flow-like mental state. *PeerJ, 3,* e851.

Barrett, L. F., & Salovey, P. (Eds.). (2002). *The wisdom in feeling: Psychological processes in emotional intelligence*. New York: Guilford Press.

Bartels, S., & Zeki, S. (2004). The neural correlated of maternal and romantic love. *NeuroImage*, *21*, 1155–1166.

Barton, J., Castillo, M., & Petrie, R. (2016). Negative campaigning, fundraising, and voter turnout: A field experiment. *Journal of Economic Behavior & Organization*, *121*, 99–113.

Bartus, R. T., Dean, R. L., Beer, B., & Lippa, A. S. (1982). The cholinergic hypothesis of geriatric memory dysfunction. *Science*, *217*, 408–414.

Bassareo, V., & Di Chiara, G. (1999). Differential responsiveness of dopamine transmission to food-stimuli in nucleus accumbens shell/core compartments. *Neuroscience*, *89*, 637–641.

Bastiaansen, L., Rossi, G., Schotte, C., & De Fruyt, F. (2011). The structure of personality disorders: Comparing the DSM-IV-TR five-

factor model framework using structural equation modeling. *Journal of Personality Disorders*, *25*, 378–396.

Bateman, D. (2001). Neurological assessment of coma. *Journal of Neurology, Neurosurgery & Psychiatry*, *71*, i13–i17.

Battaglia, M., Ogliari, A., Zanoni, A., Citterio, A., Pozzoli, U., ... Marino, C. (2005). Influence of the serotonin transporter promoter gene and shyness on children's cerebral responses to facial expressions. *Archives of General Psychiatry*, *62*, 85–94.

Battistella, G., Fornari, E., Annoni, J.-M., Chtioui, H., Dao, K., ... Giroud, C. (2014). Long-term effects of cannabis on brain structure. *Neuropsychopharmacology*, *39*, 2041–2048.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497–529.

Bauserman, R., & Davis, C. (1996). Perceptions of early sexual experiences and adult sexual adjustment. *Journal of Psychology and Human Sexuality*, *8*, 37–59.

Bavelier, D., Achtman, R. L., Mani, M., & Föcker, J. (2012). Neural bases of selective attention in action video game players. *Vision Research*, *61*, 132–143.

Bavelier, D., Green, C. S., & Dye, M. W. G. (2010). Children, wired: For better and for worse. *Neuron*, *67*, 692–701.

Baxter, A. J., Vos, T., Scott, K. M., Norman, R. E., Flaxman, A. D., ... Whiteford, H. A. (2014). The regional distribution of anxiety disorders: implications for the Global Burden of Disease Study, 2010. *International Journal of Methods in Psychiatric Research*, *23*, 422–438.

Baym, C., Corbett, B., Wright, S., & Bunge, S. (2008). Neural correlates of tic severity and cognitive control in children with Tourette syndrome. *Brain: A Journal of Neurology*, *131*, 165–179.

Bazarian, J. J., Zhong, J., Blyth, B., Zhu, T., Kavcic, V., & Peterson, D. (2007). Diffusion tensor imaging detects clinically important axonal damage after mild traumatic brain injury: A pilot study. *Journal of Neurotrauma*, *24*, 1447–1459.

Beall, E. B., Malone, D. A., Dale, R. M., Muzina, D. J., Koenig, K. A., et al. (2012). Effects of electroconvulsive therapy on brain functional activation and connectivity in depression. *Journal of ECT*, *28*, 234–241.

Beauchamp, G. K., & Mennella, J. A. (2009). Early flavor learning and its impact on later feeding behavior. *Journal of Pediatric Gastroenterology and Nutrition*, *48*, S25–S30.

Beauregard, M., Courtemanche, J., Paquette, V., & St-Pierre, E. (2009). The neural basis of unconditional love. *Psychiatry Research:*

Neuroimaging, *172*, 93–98.

Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition*, *50*, 7–15.

Beck, A. T. (1963). Thinking and depression: I. Idiosyncratic content and cognitive distortions. *Archives of General Psychiatry*, *9*, 324–333.

Beck, A. T., & Steer, R. A. (1977). *Manual for the Beck Depression Inventory*. San Antonio, TX: Psychology Corporation.

Beck, D. M., & Kastner, S. (2009). Top-down and bottom-up mechanisms in biasing competition in the human brain. *Vision Research*, *49*, 1154–1165.

Beck, H. P., Levinson, S., & Irons, G. (2009). Finding little Albert: A journey to John B. Watson's infant laboratory. *American Psychologist*, *64*, 605–614.

Becker, E. (1971). *The birth and death of meaning: An interdisciplinary perspective on the problem of man* (2nd ed.). New York: Free Press.

Becker, E. (1973). *The denial of death*. New York: Free Press.

Beebe, B., Lachmann, F., & Jaffe, J. (1997). Mother–infant interaction structures and presymbolic self and object representations. *Psychoanalytic Dialogues*, *7*, 133–182.

Beeman, E. A. (1947). The relation of the interval between castration and 1st encounter to the aggressive behavior of mind. *Anatomical Record*, *99*, 570–571.

Beilock, S. L. (2008). Math performance in stressful situations. *Current Directions in Psychological Science*, *17*, 339–343.

Beilock, S. L. (2010). *Choke: What the secrets of the brain reveal about getting it right when you have to*. New York: Free Press.

Beiser, M., & Gotowiec, A. (2000). Accounting for native/non-native differences in IQ scores. *Psychology in the Schools*, *37*, 237–252.

Béjot, Y., Jeunet, N., Garrouty, R., Maltaverne, D., Nicolleau, L., ... Didi-Roy, R. (2010). Sexsomnia: An uncommon variety of parasomnia. *Clinical Neurology and Neurosurgery*, *112*, 72–75.

Bekinschtein, T. A., Cardozo, J., & Manes, F. F. (2008). Strategies of Buenos Aires waiters to enhance memory capacity in a real-life setting. *Behavioural Neurology*, *20*, 65–70.

Bell Canada. (2015). Bell Let's Talk: The first 5 years (2010–2015). Retrieved from http://letstalk.bell.ca/letstalkprogressreport.

Bell, P. A., & Yee, L. A. (1989). Skill level and audience effects on performance of a karate drill. *Journal of Social Psychology*, *129*, 191–200.

Bell, R. A., Paterniti, D. A., Azari, R., Duberstein, P. R., & Epstein, R. M. (2010). Encouraging patients with depressive symptoms to seek care: A mixed methods approach to message development. *Patient Education and Counseling*, *78*, 198–205.

Belletier, C., Normand, A., & Huguet, P. (2019). Social-facilitation-and-impairment effects: From motivation to cognition and the social brain. *Current Directions in Psychological Science*, *28*, 260–265.

Belsky, J., & Rovine, M. (1990). Patterns of marital change across the transition to parenthood. *Journal of Marriage and the Family*, *52*, 109–123.

Bem, S. L. (1981). Gender schema theory: A cognitive account of sex typing. *Psychological Review*, *88*, 354–364.

Bem, S. L. (1993). *The lenses of gender: Transforming the debate on sexual inequality*. New Haven, CT: Yale University Press.

Bem, S. L., & Bem, D. J. (1973). Does sex-biased job advertising "aid and abet" sex discrimination? *Journal of Applied Social Psychology*, *3*, 6–18.

Benbow, C. P., & Stanley, J. C. (1983). Sex differences in mathematical reasoning ability: More facts. *Science*, *222*, 1029–1031.

Benedict, R. (1938). Continuities and discontinuities in cultural conditioning. *Psychiatry: Journal for the Study of Interpersonal*

Processes, *2*, 161–167.

Benet-Martinez, V., & John, O. P. (1998). Los Cinco Grandes across cultures and ethnic groups: Multitrait method analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology*, *75*, 729–750.

Bennett, G. G., Wolin, K. Y., Robinson, E. L., Fowler, S., & Edwards, C. L. (2005). Racial/ethnic harassment and tobacco use among African American young adults. *American Journal of Public Health*, *95*, 238–240.

Berger, J. M., Levant, R., McMillan, K. K., Kelleher, W., & Sellers, A. (2005). Impact of gender role conflict, traditional masculinity ideology, alexithymia, and age on men's attitudes towards psychological help seeking. *Psychology of Men & Masculinity*, *6*, 73–78.

Berger, R., & Phillips, N. (1995). Energy conservation and sleep. *Behavioural Brain Research*, *69*, 65–73.

Berkman, L. F., & Breslow, L. (1983). *Health and ways of living: The Alameda county study*. New York: Oxford University Press.

Berlim, M. T., van den Eynde, F., Tavor-Perdomo, S., & Daskalakis, Z. J. (2014). Response, remission, and drop-out rates following high-frequency repetitive transcranial magnetic stimulation (rTMS) for treating major depression: A systematic review and meta-analysis

of randomized, double-blind and sham-controlled trials. *Psychological Medicine*, *44*, 224–239.

Berlin, B. (1974). *Principles of Tzeltal plant classification*. New York: Academic Press.

Berlingeri, M., Bottini, D. L., Sberna, M., & Paulesu, E. (2013). Reassessing the HAROLD model. Is the hemispheric asymmetry reduction in older adults a special case of compensatory-related utilization of neural circuits? *Experimental Brain Research*, *224*, 393–410.

Berlucchi, G. (2011). Brain plasticity and cognitive neurorehabilitation. *Neuropsychological Rehabilitation*, *21*, 560–578.

Berns, G. S., Chappelow, J., Fink, C. F., Pagnoni, G., Martin-Skurski, M. E., & Richards, J. (2005). Neurobiological correlates of social conformity and independence during mental rotation. *Biological Psychiatry*, *58*, 245–253.

Berntsen, D., & Thomsen, D. K. (2005). Personal memories for remote historical events: accuracy and clarity of flashbulb memories related to World War II. *Journal of Experimental Psychology: General*, *134*, 242–257.

Berquier, A., & Ashton, R. (1992). Characteristics of the frequent nightmare sufferer. *Journal of Abnormal Psychology*, *101*, 246–250.

Berridge, C. W., & Waterhouse, B. D. (2003). The locus coeruleus-noradrenergic system: Modulation of behavioural state and state-dependent cognitive processes. *Brain Research Reviews*, *42*, 33–84.

Berridge, K. C., Robinson, T. E., & Aldridge, J. W. (2009). Dissecting components of reward: "liking", "wanting", and learning. *Current Opinion in Pharmacology*, *9*, 65–73.

Berry, S. L., Beatty, W. W., & Klesges, R. C. (1985). Sensory and social influences on ice-cream consumption by males and females in a laboratory setting. *Appetite*, *6*, 41–45.

Bestmann, S. (2008). The physiological basis of transcranial magnetic stimulation. *Trends in Cognitive Sciences*, *12*, 81–83.

Bevan, T. E. (2014). *The psychobiology of transsexualism and transgenderism*. Santa Barbara: CA: Praeger Publishers.

Bezeau, S., & Graves, R. (2001). Statistical power and effect sizes of clinical neuropsychology research. *Journal of Clinical and Experimental Neuropsychology*, *23*, 399–406.

Bhatara, A., Tirovolas, A., Duan, L. M., Levy, B., & Levitin, D. J. (2011). Perception of emotional expression in musical performance. *Journal of Experimental Psychology: Human Perception and Performance*, *37*, 921–934.

Bhattacharya, J., & Bundorf, M. K. (2005). The incidence of healthcare costs of obesity. Working Paper #11303. National Bureau of Economic Research.

Bhugra, D. (2005). The global prevalence of schizophrenia. *PloS Medicine*, *2*, 372–373.

Bialystok, E. (2009). International symposium on bilingualism lecture. *Bilingualism: Language and Cognition*, *12*, 3–11.

Bialystok, E. (2011a). Reshaping the mind: The benefits of bilingualism. *Canadian Journal of Experimental Psychology*, *65*, 229–235.

Bialystok, E. (2011b). Coordination of executive functions in monolingual and bilingual children. *Journal of Experimental Child Psychology*, *110*, 461–468.

Bialystok, E., Craik, F. I. M., & Freedman, M. (2007). Bilingualism as a protection against the onset of symptoms of dementia. *Neuropsychologia*, *45*, 459–464.

Bialystok, E., Craik, F. I. M., Klein, R., & Viswanathan, M. (2004). Bilingualism, aging, cognitive control: Evidence from the Simon task. *Psychology & Aging*, *19*, 290–303.

Bigelow, H. J. (1850). Dr. Harlow's case of recovery from the passage of an iron bar through the head. *American Journal of Medical Sciences*, *20*, 13–22.

Birbaumer, N., Veit, R., Lotze, M., Erb, M., Hermann, C., … Flor, H. (2005). Deficient fear conditioning in psychopathy: A functional magnetic resonance imaging study. *Archives of General Psychiatry*, *62*, 799–805.

Bisiach, E., & Luzzatti, C. (1978). Unilateral neglect of representational space. *Cortex*, *14*, 129–133.

Bjork, R. A., & Whitten, W. B. (1974). Recency-sensitive retrieval processes in long-term free recall. *Cognitive Psychology*, *6*, 173–189.

Blackwell, L., Trzesniewski, K., & Dweck, C. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, *78*, 246–263.

Blair, C. (2006). How similar are fluid cognition and general intelligence? A developmental neuroscience perspective on fluid cognition as an aspect of human cognitive ability. *Behavioral and Brain Sciences*, *29*, 109–160.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 64–663.

Blair, K. L., & Hoskin, R. A. (2016). Contemporary understandings of femme identities and related experiences of discrimination. *Psychology & Sexuality*, *7*, 101–115.

Blair, R. J. R. (2010a). Neuroimaging of psychopathy and antisocial behavior: A targeted review. *Current Psychiatry Reports*, *12*, 76–82.

Blair, R. J. R. (2010b). Psychopathy, frustration, and the role of reactive aggression: The role of the ventromedial prefrontal cortex. *British Journal of Psychology*, *101*, 383–399.

Blake, R., Palmeri, T. J., Marois, R., & Kim, C.-Y. (2005). On the perceptual reality of synesthetic color. In L. C. Robertson & N. Sagiv (Eds.), *Synesthesia* (pp. 47–73). Oxford, UK: Oxford University Press.

Blakemore, S-J. (2018). Avoiding social risk in adolescence. *Current Directions in Psychological Science*, *27*, 116–122.

Blandin, Y., & Proteau, L. (2000). On the cognitive basis of observational learning: Development of mechanisms for the detection and correction of errors. *Quarterly Journal of Experimental Psychology: Human Experimental Psychology*, *53*, 846–867.

Blesa, J., Phani, S., Jackson-Lewis, V., & Pzedborski, S. (2012). Classic and new animal models of Parkinson's Disease. *Journal of Biomedicine and Biotechnology*, *2012*, 845618.

Bliss, T., & Collingridge, G. L. (1993). A synaptic model of memory: Long-term potentiation in the hippocampus. *Nature*, *361*, 31–39.

Bliss, T., & Lømo, T. (1973). Long-lasting potentiation of synaptic transmission in the dentate area of the anaesthetized rabbit following stimulation of the perforant path. *Journal of Physiology*, *232*, 331–356.

Block, R. I., O'Leary, D. S., Hichwa, R. D., Augustinack, J. C., Ponto, L. L. B., Ghoneim, M. M., et al. (2002). Effects of frequent marijuana use on memory-related regional cerebral blood flow. *Pharmacology Biochemistry and Behavior*, *72*, 237–250.

Boak, A., Hamilton, H. A., Adlaf, E. M., Henderson, J. L., & Mann, R. E. (2016). *The mental health and well-being of Ontario students, 1991–2015: Detailed OSDUHS findings*. CAMH Research Document Series no. 43. Toronto: Centre for Addiction and Mental Health.

Boak, A., Hamilton, H. A., Adlaf, E. M., & Mann, R. E. (2016). *Drug use among Ontario students, 1977–2015: Detailed OSDUHS findings (CAMH Research Document Series No. 41)*. Toronto, ON: Centre for Addiction and Mental Health.

Boesch, C. (1991). Teaching among wild chimpanzees. *Animal Behaviour*, *41*, 530–532.

Boettcher, L. B., & Menacho, S. T. (2017). The early argument for prefrontal leucotomy: the collision of frontal lobe theory and psychosurgery at the 1935 International Neurological Congress in London. *Journal of Neurosurgery*, *43*, 1–6.

Bogaert, A. F. (2008). Menarche and father absence in a national probability sample. *Journal of Biosocial Sciences*, *40*, 623–636.

Bogle, K. E., & Smith, B. H. (2009). Illicit methylphenidate use: A review of prevalence, availability, pharmacology, and consequences. *Current Drug Abuse Reviews*, *2*, 157–176.

Bohart, A., Elliott, R., Greenberg, L., & Watson, J. (2002). Empathy. In J. C. Norcross (Ed.), *Psychotherapy relationships that work: Therapist contributions and responsiveness to patients* (pp. 89–108). New York: Oxford University Press.

Bohart, A. C. (2003). *Person-centered psychotherapy and related experiential approaches* (pp. 107–148). New York: Guilford Press.

Boldizar, J. P., Wilson, K. L., & Deemer, D. K. (1989). Gender, life experiences, and moral judgment development: A process-oriented approach. *Journal of Personality and Social Psychology*, *57*, 229–238.

Bolla, K. I., Brown, K., Eldreth, D., Tate, K., & Cadet, J. L. (2002). Dose-related neurocognitive effects of marijuana use. *Neurology*, *59*, 1337–1343.

Boly, M., Faymonville, M. E., Peigneux, P., Lambermont, B., Damas, P., Del Fiore, G., et al. (2004). Auditory processing in severely brain injured patients: Differences between the minimally conscious state and the persistent vegetative state. *Archives of Neurology*, *61*, 233–238.

Bonebakker, A. E., Bonke, B., Klein, J., Wolters, G., Stijen, T., Passchier, J., et al. (1996). Information processing during general anesthesia: Evidence for unconscious memory. *Memory & Cognition*, *24*, 766–776.

Boomsma, D. I., Van Beijsterveldt, C. E. M., & Hudziak, J. J. (2005). Genetic and environmental influences on anxious/depression during childhood: A study from the Netherlands Twin Register. *Genes, Brain, and Behavior*, *4*, 466–481.

Boone, A. P., & Hegarty, M. (2017). Sex differences in mental rotation tasks: Not just in the mental rotation process! *Journal of Experimental Psychology: Learning Memory and Cognition*, *43*, 1005–1019.

Booth, A., Shelley, G., Mazur, A., Tharp, G., & Kittok, R. (1989). Testosterone, and winning and losing in human competition. *Hormones & Behavior*, *23*, 556–571.

Born, J., Lange, T., Hansen, K., Molle, M., & Fehm, H. L. (1997). Effects of sleep and circadian rhythm on human circulating immune cells. *The Journal of Immunology*, *158*, 4454–4464.

Borrelli, F., & Izzo, A. A. (2009). Herb–drug interactions with St. John's wort (Hypericum perforatum): An update on clinical observations. *American Association of Pharmaceutical Scientists' Journal*, *11*, 710–727.

Bötzel, K., Schulze, S., & Stodieck, S. R. (1995). Scalp topography and analysis of intracranial sources of face-evoked potentials. *Experimental Brain Research*, *104*, 135–143.

Bouchard, T. J., Lykken, D. T., McGue, M., Segal, N. L., & Tellegen, A. (1990). Sources of human psychological differences: The Minnesota study of twins reared apart. *Science*, *250*, 223–228.

Bourdage, J. S., Lee, K., Ashton, M. C., & Perry, A. (2007). Big Five and HEXACO model personality correlates of sexuality. *Personality and Individual Differences*, *43*, 1506–1516.

Bouton, M. E. (1994). Context, ambiguity, and classical conditioning. *Current Directions in Psychological Science*, *3*, 49–53.

Bouton, M. E. (2002). Context, ambiguity, and unlearning: Sources of relapse after behavioral extinction. *Biological Psychiatry*, *52*, 976–986.

Boveroux, P., Vanhaudenhuyse, A., Bruno, M. A., Noirhomme, Q., Lauwick, S., ... & Boly, M. (2010). Breakdown of within- and between-network resting state functional magnetic resonance imaging connectivity during propofol-induced loss of consciousness. *Anesthesiology*, *113*, 1038–1053.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129–148.

Bowker, A., Boekhoven, B., Nolan, A., Bauhaus, S., Glover, P., ... Taylor, S. (2009). Naturalistic observations of spectator behavior at youth hockey games. *The Sport Psychologist*, *23*, 301–316.

Bowlby, J. (1951). Maternal care and mental health. *World Health Organization Monograph*, Serial No. 2.

Boyce, W., Doherty-Poirier, M., MacKinnon, D., Fortin, C., Saab, H., ... Gallupe, O. (2006). Sexual health of Canadian youth: Findings from the Canadian youth, sexual health and HIV/AIDS study. *Canadian Journal of Human Sexuality*, *15*, 59–68.

Bozionelos, N., Bozionelos, G., Polychroniou, P., & Kostopoulos, K. (2014). Mentoring receipt and personality: Evidence for non-linear relationships. *Journal of Business Research*, *67*, 171–181.

Bracha, H., Ralston, T., Matsukawa, J., Williams, A., & Bracha, A. (2004). Does "fight or flight" need updating? *Psychosomatics: Journal of Consultation Liaison Psychiatry*, *45*, 448–449.

Bradley, R. H., Whiteside, L., Caldwell, B., Casey, P. H., Kelleher, K., et al. (1993). Maternal IQ, the home environment, and child IQ in low birthweight, premature children. *International Journal of Behavioral Development*, *16*, 61–74.

Brain Injury Canada. (2016). About acquired brain injury. Retrieved from http://braininjurycanada.ca/acquired-brain-injury/

Brain Tumour Foundation of Canada. (2013). Brain tumour fact*s*. Retrieved from www.braintumour.ca/2494/brain-tumour-facts

Brainard, D. H., & Hurlbert, A. C. (2015). Colour vision: Understanding #TheDress. *Current Biology*, *25*, R551–R554.

Branch, C. H., & Eurman, L. J. (1980). Social attitudes towards patients with anorexia nervosa. *The American Journal of Psychiatry*, *137*, 631–632.

Branch, G (2018, November 30). Polling evolution in Canada. Retrieved from https://ncse.com/news/2018/11/polling-evolution-canada–0018825

Bransford, J. D., & Johnson, M. K. (1973). Considerations of some problems of comprehension. In W. Chase (Ed.), *Visual information processing* (pp. 383–438). Oxford, UK: Academic.

Bratsberg, B., & Rogeberg, O. (2018). Flynn effect and its reversal are both environmentally caused. *Proceedings of the National Academy of Science USA*, *115*, 6674–6678.

Braver, T. S., & Barch, D. M. (2002). A theory of cognitive control, aging cognition, and neuromodulation. *Neuroscience and Biobehavioral Reviews*, *26*, 809–817.

Brefczynski-Lewis, J. A., Lutz, A., Schaefer, H. S., Levinson, D. B., & Davidson, R. J. (2007). Neural correlates of attentional expertise in

long-term meditation practitioners. *Proceeding of the National Academy of Sciences*, *104*, 11483–11488.

Brien, S., Grenier, L., Kapral, M., Kurdyak, P., & Vigod, S. (2015). *Taking Stock: A report on the quality of mental health and addictions services in Ontario*. An HQO/ICES Report. Toronto: Health Quality Ontario and the Institute for Clinical Evaluative Sciences.

Brion, M. J., Victora, C., Matijasevich, A., Horta, B., Anselmi, L., ... Davey Smith, G. (2010). Maternal smoking and child psychological problems: Disentangling causal and noncausal effects. *Pediatrics*, *126*, e57–e65.

Broca, P. (1861). Remarques sur le siège de la faculté du langage articule, suivies dune observation daphémie (Perte de la Parole). *Bulletin de la Societé Anatomique de Paris*, *6*, 330–357.

Brondolo, E., Brady, N., Thompson, S., Contrada, R. J., Cassells, A., ... Sweeney, M. (2008a). Perceived racism and negative affect: Analyses of trait and state measures of affect in a community sample. *Journal of Social and Clinical Psychology*, *27*, 150–173.

Brondolo, E., Libby, D. J., Denton, E., Thompson, S., Schwartz, J., Sweeney, M., et al. (2008b). Racism and ambulatory blood pressure in a community sample. *Psychosomatic Medicine*, *70*, 49–56.

Brook, J. S., Stimmel, M. A., Zhang, C., & Brook, D. W. (2008). The association between earlier marijuana use and subsequent

academic achievement and health problems: A longitudinal study. *American Journal of Addiction*, *17*, 155–160.

Brooks, D. C., Palmatier, M. I., Garcia, E. O., & Johnson, J. L. (1999). An extinction cue reduced spontaneous recovery of a conditioned taste aversion. *Animal Learning & Behavior*, *27*, 77–88.

Brotto, L. A., Chik, H. M., Ryder, A. G., Gorzalka, B. B., & Seal, B. N. (2005). Acculturation and sexual function in Asian women. *Archives of Sexual Behavior*, *34*, 613–626.

Brown, A. S., & Derkits, E. J. (2010). Prenatal infection and schizophrenia: A review of epidemiologic and translational studies. *American Journal of Psychiatry*, *167*, 261–280.

Brown, A. S., & McNeil, D. (1966). The "tip of the tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior*, *5*, 325–337.

Brown, C. C., Carroll, J. S., Yorgason, J. B., Busby, D. M., Willoughby, B. J., & Larson, J. H. (2017). A common-fate analysis of pornography acceptance, use, and sexual satisfaction among heterosexual married couples. *Archives of Sexual Behavior*, *46*, 575–584.

Brown, G. W., Birley, J. L., & Wing, J. K. (1972). Influence of family life on the course of schizophrenic disorders: A replication. *The British Journal of Psychiatry*, *121*, 251–258.

Brown, J. (1958). Some tests of decay theory of immediate memory. *Quarterly Journal of Experimental Psychology*, *10*, 12–24.

Brown, J. M. (2003). Eyewitness memory for arousing events: Putting things into context. *Applied Cognitive Psychology*, *17*, 93–106.

Brown, M., Keyner, R., & Lumsden, A. (2001). *The developing brain*. Oxford, UK: Oxford University Press.

Brown, R. E., & Milner, P. M. (2003). The legacy of Donald O. Hebb: More than the Hebb Synapse. *Nature Reviews Neuroscience*, *4*, 1013–1019.

Brown, R. E., Basheer, R., McKenna, J. T., Strecker, R. E., & McCarley, R. W. (2012). Control of sleep and wakefulness. *Physiology Review*, *92*, 1087–1187.

Brown, R., & Kulik, J. (1977). Flashbulb memories. *Cognition*, *5*, 73–99.

Bruck, M., & Ceci, S. J. (1999). The suggestibility of children's memory. *Annual Review of Psychology*, *50*, 419–439.

Brunell, A. B., Staats, S., Barden, J., & Hupp, J. M. (2011). Narcissism and academic dishonesty: The exhibitionism dimension and the lack of guilt. *Personality and Individual Differences*, *50*, 323–328.

Buck, L. B., & Axel, R. (1991). A novel multigene family may encode odorant receptors: A molecular basis for odor recognition. *Cell*, *65*,

175–187.

Buckels, E. E., Trapnell, P. D., Andjelovic, T., & Paulhus, D. L. (2018). Internet trolling and everyday sadism: Parallel effects on pain perception and moral judgment. *Journal of Personality*, *87*, 328–340.

Buckholtz, J. W., Treadway, M. T., Cowan, R. L., Woodward, N. D., Li, R., Ansari, M. S., Baldwin, R. M., et al. (2010). Dopaminergic network differences in human impulsivity. *Science*, *329*, 532.

Buehlman, K. T., Gottman, J. M., & Katz, L. F. (1992). How a couple views their past predicts their future: Predicting divorce from an oral history interview. *Journal of Family Psychology*, *5*, 295–318.

Bugg, J. M., Zook, N. A., DeLosh, E. L., Davalos, D. B., & Davis, H.P. (2006). Age differences in fluid intelligence: Contributions of general slowing and frontal decline. *Brain and Cognition*, *62*, 9–16.

Bukhari, I. A., & Dar, A. (2013). Behavioral profile of *hypericum performatum* (St. John's wort) extract. A comparison with standard antidepressants in animal models of depression. *European Review for Medical and Pharmacological Sciences*, *17*, 1082–1089.

Bunn, E. M., Tyler, L. K., & Moss, H. E. (1998). Category-specific semantic deficits: The role of familiarity and property type reexamined. *Neuropsychology*, *12*, 367–379.

Burger, J. M. (1999). The foot-in-the-door compliance procedure: A multiple-process analysis and review. *Personality and Social Psychology Review*, *3*, 303–325.

Burghardt, G. M., & Bowers, R. I. (2017). From instinct to behavior systems: An integrated approach to ethological psychology. In J. Call, G. M. Burghardt, I. M. Pepperberg, C. T. Snowdon, & T. Zentall (Eds.), *APA handbook of comparative psychology: Basic concepts, methods, neural substrate, and behavior* (pp. 333–364). Washington, D.C.: American Psychological Association.

Burkam, D. T., Ready, D. D., Lee, V. E., & LoGerfo, L. F. (2004). Social-class differences in summer learning between kindergarten and first grade: Model specification and estimation. *Sociology of Education*, *77*, 1–31.

Burke, B. L., Kosloff, S., & Landau, M. J. (2013). Death goes to the polls: A meta-analysis of mortality salience effects on political attitudes. *Political Psychology*, *34*, 183–199.

Burke, B. L., Martens, A., & Faucher, E. H. (2010). Two decades of terror management theory: A meta-analysis of mortality salience research. *Personality and Social Psychology Review*, *14*, 155–195.

Burke, T. M., Markwald, R. R., McHill, A. W., Chinoy, E. D., Snider, J. A., … & Wright, Jr., K. P. (2015). Effects of caffeine on the human circadian clock in vivo and in vitro. *Science Translational Medicine*, *16*, 305.

Burnand, Y., Andreoli, A., Kolatte, E., Venturini A., & Rosset, N. (2002). Psychodynamic psychotherapy and clomipramine in the treatment of major depression. *Psychiatric Services*, *53*, 585–580.

Burns, M., & Seligman, M. (1989). Explanatory style across the life span: Evidence for stability over 52 years. *Journal of Personality and Social Psychology*, *56*, 471–477.

Buschkuehl, M., Jaeggi, S. M., Hutchison, S., Perrig-Chiello, P., Däpp, C., Müller, M., et al. (2008). Impact of working memory training on memory performance in old-old adults. *Psychology and Aging*, *23*, 743–753.

Bushman, B. J., & Anderson, C. A. (2007). Measuring the strength of the effect of violent media on aggression. *American Psychologist*, *62*, 253–254.

Bushman, B. J., & Anderson, C. A. (2009). Comfortably numb: Desensitizing effects of violent media on helping others. *Psychological Science*, *20*, 273–277.

Bushman, B. J., Moeller, S. J., & Crocker, J. (2011). Sweets, sex, or self-esteem? Comparing the value of self-esteem boosts with other pleasant rewards. *Journal of Personality*, *79*, 993–1012.

Buss, D. M. (1989). Sex differences in human mating preferences: Evolutionary hypotheses tested in 37 different cultures. *Behavioral and Brain Sciences*, *12*, 1–49.

Buss, D. M. (2003). *The evolution of desire: Strategies of human mating*. New York: Basic Books.

Buss, D. M. (2009). How can evolutionary psychology successful explain personality and individual differences? *Current Perspectives on Psychological Science*, *4*, 359–366.

Busse, D., Yim, I. S., Campos, B., & Marshburn, C. K. (2017). Discrimination and the HPA axis: Current evidence and future directions. *Journal of Behavioral Medicine*, *40*, 539–552.

Buston, P. M., & Emlen, S. T. (2003). Cognitive processes underlying human mate choice: The relationship between self-perception and mate preference in Western society. *Proceedings of the National Academy of Sciences*, *100*, 8805–8810.

Butcher, L. M., Davis, O. S. P., Craig, I. W., & Plomin, R. (2008). Genome-wide quantitative trait locus association scan of general cognitive ability using pooled DNA and 500K single nucleotide polymorphism microarrays. *Genes, Brains and Behavior*, *7*, 435–446.

Butler, B., & Klein, R. (2009). Inattentional blindness for ignored words: Comparison of explicit and implicit memory tasks. *Consciousness & Cognition*, *18*, 811–819.

Butterweck, V. (2003). Mechanisms of action of St. John's wort in depression: What is known? *CNS Drugs*, *17*, 539–562.

Button, E. J., Sonuga-Barke, E. J., Davies, J., & Thompson, M. (1996). A prospective study of self-esteem in the reduction of eating problems in adolescent schoolgirls: Questionnaire findings. *British Journal of Clinical Psychology*, *35*, 193–203.

Byers, E. S., Sears, H. A., & Foster, L. R. (2013). Factors associated with middle school students' perceptions of the quality of school-based sexual health education. *Sex Education*, *13*, 214–227.

Cabeza, R. (2002). Hemispheric asymmetry reduction in older adults: The HAROLD model. *Psychology and Aging*, *17*, 85–100.

Caci, H., Deschaux, O., Adan, A., & Natale, V. (2009). Comparing three morningness scales: Age and gender effects, structure and cut-off criteria. *Sleep Medicine*, *10*, 240–245.

Cacioppo, J. T., & Cacioppo, S. (2014). Social relationships and health: The toxic effects of perceived social isolation. *Social and Personality Psychology Compass*, *8*, 58–72.

Cacioppo, J. T., & Hawkley, L. C. (2003). Social isolation and health, with an emphasis on underlying mechanisms. *Perspectives in Biology and Medicine*, *46*, S39–S52.

Cacioppo, J. T., Hawkley, L. C., & Berntson, G. G. (2003). The anatomy of loneliness. *Current Directions in Psychological Science*, *12*, 71–74.

Cacioppo, J. T., Hawkley, L. C., Norman, G. J., & Berntson, G. G. (2011). Social isolation. *Annuals of the New York Academy of Sciences*, *1231*, 17–22.

Cacioppo, J. T., Hughes, M. E., Waite, L. J., Hawkley, L. C., & Thisted, R. A. (2006). Loneliness as a specific risk factor for depressive symptoms: Cross-sectional and longitudinal analyses. *Psychology and Aging*, *21*, 140–151.

Cacioppo, J. T., Petty, R. E., Kao, C., & Rodriguez, R. (1986). Central and peripheral routes to persuasion: An individual difference perspective. *Journal of Personality and Social Psychology*, *51*, 1032–1043.

Cacioppo, J. T., Reis, H. T., & Zautra, A. J. (2011). Social resilience. *American Psychologist*, *66*, 43–51.

Cahn, B. R., & Polich, J. (2006). Meditation states and traits: EEG, ERP and neuroimaging studies. *Psychological Bulletin*, *132*, 180–211.

Cai, D. J., Mednick, S. A., Harrison, E. M., Kanady, J. C., & Mednick, S. C. (2009). REM, not incubation, improves creativity by priming associative networks. *Proceedings of the National Academy of Science USA*, *106*, 10130–10134.

Cain, N., & Gradisar, M. (2010). Electronic media use and sleep in school-aged children and adolescents A review. *Sleep Medicine, 11,* 735–742.

Cairns, R., & Cairns, B. (1994). *Lifelines and risks: Pathways of youth in our time*. New York: Cambridge University Press.

Caldwell, H. K., & Young, W. S. (2006). Oxytocin and vasopressin: Genetics and behavioral implications. In A. Lajtha & R. Lim (Eds.), *Handbook of neurochemistry and molecular neurobiology* (pp. 573–607). Berlin: Springer-Verlag.

Campos, J. J., Bertenthal, B. I., & Kermoian, R. (1992). Early experience and emotional development: The emergence of wariness of heights. *Psychological Science*, *3*, 61–64.

Canadian Medical Association. (2008). *8th Annual National Report Card on Health Care, August 2008*. Ottawa, ON: Author. www.cma.ca/multimedia/CMA/Content_Images/Inside_cma/Annual_Meeting/2008/GC_Bulletin/National_Report_Card_EN.pdf.

Canadian Paediatric Society, Digital Health Task Force. (2017). Screen time and young children: Promoting health and development in a digital world. *Paediatrics and Child Health*, *22*, 461–468.

Canadian Psychological Association. (2016). *"Psychology Works" fact sheet: Gender dysphoria in adolescents and adults*. Ottawa, ON: Canadian Psychological Association.

Canli, T., Sivers, H., Whitfield, S. L., Gotlib, I. H., & Gabrieli, J. D. E. (2002). Amygdala response to happy faces as a function of extraversion. *Science*, *296*, 2191.

Cannon, M., Jones, P. B., & Murray, R. M. (2002). Obstetric complications and schizophrenia: historical and meta-analytic review. *American Journal of Psychiatry*, *159*, 1080–1092.

Cannon, W. B. (1929). *Bodily changes in pain, hunger, fear, and rage*. New York: Appleton-Century-Crofts.

Cao, X., Cui, Z., Feng, R., Tang, Y., Qin, Z., ... Tsien, J. (2007). Maintenance of superior learning and memory function in NR2B transgenic mice during ageing. *European Journal of Neuroscience*, *25*, 1815–1822.

Cao-Lei, L., de Rooij, S. R., King, S., Matthews, S. G., Metz, G. A. S., Roseboom, T. J., & Szyf, M. (2017). Prenatal stress and epigenetics. *Neuroscience and Biobehavioral Reviews*. pii: S0149-7634(16) 30726–6.

Capafons, A., Mendoza, M., Espejo, B., Green, J., Lopes-Pires, C., Selma, M., et al. (2008). Attitudes and beliefs about hypnosis: A multicultural study. *Contemporary Hypnosis*, *25*, 141–155.

Cappadocia, M. C., Desrocher, M., Pepler, D., & Schroeder, J. H. (2009). Contextualizing the neurobiology of conduct disorder in an emotion dysregulation framework. *Clinical Psychology Review*, *29*, 506–518.

Cappo, B. M., & Holmes, D. S. (1984). The utility of prolonged respiratory exhalation for reducing physiological and psychological

arousal in non-threatening and threatening situations. *Journal of Psychosomatic Research*, *28*, 265–273.

Caramazza, A., & Mahon, B. Z. (2003). The organization of conceptual knowledge: The evidence from category-specific semantic deficits. *Trends in Cognitive Sciences*, *7*, 354–361.

Caramazza, A., & Shelton, J. R. (1998). Domain-specific knowledge systems in the brain: The animate-inanimate distinction. *Journal of Cognitive Neuroscience*, *10*, 1–34.

Carek, P. J., Laibstain, S. E., & Care, S. M. (2011). Exercise for the treatment of depression and anxiety. *International Journal of Psychiatry in Medicine*, *41*, 15–28.

Carhart-Harris R. L., Roseman, L., Haijen. E., Erritzoe, D., Watts, R., ... Kaelen, M. (2018). Psychedelics and the essential importance of context. *Journal of Psychopharmacology*, *32*, 725–731.

Carhart-Harris, R. L., Muthukumaraswamy, S., Roseman, L., Kaelen, M., Droog, W., Murphy, K., ... Nutt, D. J. (2016). Neural correlates of the LSD experience revealed by multimodal neuroimaging. *Proceedings of the National Academy of Science USA*, *113*, 4853–4858.

Carhart-Harris, R. L., Wall, M. B., Erritzoe, D., Kaelen, M., Ferguson, B., ... Nutt, D. J. (2014). The effect of acutely administered MDMA on subjective and BOLD-fMRI responses to favourite and worst autobiographical memories. *International Journal of Neuropsychopharmacology*, *17*, 527–540.

Carise, D., Dugosh, K. L., McLellan, A. T., Camilleri, A., Woody, G. E., & Lynch, K. G. (2007). Prescription OxyContin abuse among patients entering addiction treatment. *American Journal of Psychiatry*, *164*, 1750–1756.

Carliner, H., Delker, E., Fink, D .S., Keyes, K. M., & Hasin, D. S. (2016). Racial discrimination, socioeconomic position, and illicit drug use among US Blacks. *Social Psychiatry and Psychiatric Epidemiology*, *51*, 551–560.

Carnagey, N. L., Anderson, C. A., & Bushman, B. J. (2007). The effect of video game violence on physiological desensitization to real-life violence. *Journal of Experimental Social Psychology*, *43*, 489–496.

Carmichael, M. S., Warburton, V. L., Dixen, J. & Davidson, J. M. (1994). Relationships among cardiovascular, muscular, and oxytocin responses during human sexual activity. *Archives of Sexual Behavior*, *23*, 59–79.

Carmody, T. P., Duncan, C., Simon, J. A., Solkowitz, S., Huggins, J., Lee, S., & Delucchi, K. (2008). Hypnosis for smoking cessation: A randomized trial. *Nicotine & Tobacco Research*, *10*, 811–818.

Carmona, J. E., Holland, A. K., & Harrison, D. W. (2009). Extending the functional cerebral systems theory of emotion to the vestibular modality: A systematic and integrative approach. *Psychological Bulletin*, *135*, 286–302.

Carney, D. R. (n.d.). My position on “power poses.” Retrieved from http://faculty.haas.berkeley.edu/dana_carney/pdf_my%20position%20on%20power%20poses.pdf

Carney, D. R., Cuddy, A. J. C., & Yap, A. J. (2010). Power posing: Brief nonverbal displays affect neuroendocrine levels and risk tolerance. *Psychological Science*, *21*, 1363–1368.

Carpendale, J. I. (2000). Kohlberg and Piaget on stages and moral reasoning. *Developmental Review*, *20*, 181–205.

Carpenter, C., Eppink, S. T., Gonzales, Jr., G., & McKay, T. (2018). Effects of access to legal same-sex marriage on marriage health: Evidence from BRFSS. National Bureau of Economic Research working paper. doi: 10.3386/w24651.

Carr, C. E., & Konishi, M. (1990). A circuit for detection of interaural time differences in the brain stem of the barn owl. *Journal of Neuroscience*, *10*, 3227–3246.

Carré, J. M., Putnam, S. K., & McCormick, C. M. (2009). Testosterone responses to competition predict future aggressive behaviour at a cost to reward in men. *Psychoneuroendocrinology*, *34*, 561–570.

Carroll, A. (2009). Are you looking at me? Understanding and managing paranoid personality disorder. *Advances in Psychiatry Treatment*, *15*, 40–48.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor analytic studies*. Cambridge, U.K.: Cambridge University Press.

Carstensen, L. L., Isaacowitz, D., & Charles, S. T. (1999). Taking time seriously: A theory of socioemotional selectivity. *American Psychologist*, *54*, 165–181.

Carston, R. (2002). *Thoughts and utterances: The pragmatics of explicit conversation*. New York: Blackwell.

Carter, A. C., Brandon, K., & Goldman, M. S. (2010). The college and noncollege experience: A review of the factors that influence drinking behavior in young adulthood. *Journal of Studies on Alcohol and Drugs*, *71*, 742–750.

Carter, C. S. (1998). Neuroendocrine perspectives on social attachment and love. *Psychoneuroendocrinology*, *23*, 779–818.

Carter, C. S., Braver, T. S., Barch, D. M., Botvinick, M. M., Noll, D., & Cohen, J. D. (1998). Anterior cingulate cortex, error detection, and the online monitoring of performance. *Science*, *280*, 747–749.

Carter, N. T., Miller, J. D., & Widiger, T. A. (2018). Extreme personalities at work and in life. *Current Directions in Psychological Science*, *27*, 429–436.

Cartwright, R., Agargun, M., Kirkby, J., & Friedman, J. K. (2006). Relation of dreams to waking concerns. *Psychiatry Research*, *141*, 261–270.

Caruso, E. M., Waytz, A., & Epley, N. (2010). The intentional mind and the hot hand: Perceiving intentions makes streaks seem likely to continue. *Cognition*, *116*, 149–153.

Casey, B. J., Jones, R. M., & Hare, T. A. (2008). The adolescent brain. *Annals of the New York Academy of Sciences*, *1124*, 111–126.

Caspi, A. (2000). The child is father of the man: Personality continuities from childhood to adulthood. *Journal of Personality and Social Psychology*, *78*, 158–172.

Caspi, A., Hariri, A. R., Holmes, A., Uher, R., & Moffitt, T. E. (2010). Genetic sensitivity to the environment: The case of the serotonin transporter gene and its implications for studying complex diseases and traits. *American Journal of Psychiatry*, *167*, 509–527.

Caspi, A., Moffitt, T. E., Cannon, M., Taylor, A., Craig, I. W., ... Poulton, R. (2005). Moderation of the effect of adolescent-onset cannabis use on adult psychosis by a functional polymorphism in the catechol-*O*-methyltransferase gene: Longitudinal evidence of a gene X environment interaction. *Biological Psychiatry*, *57*, 1117–1127.

Caspi, A., Sugden, K., Moffitt, T. E., Taylor, A., Craig, I. W., ... Poulton, R. (2003). Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science*, *301*, 386–389.

Castrén, E., & Rantamäki, T. (2010). The role of BDNF and its receptors in depression and antidepressant drug action: Reactivation of

developmental plasticity. *Developmental Neurobiology*, *70*, 289–297.

Cattell, R. B. (1946). *The description and measurement of personality*. New York: Harcourt, Brace & World.

Cattell, R. B. (1971). *Abilities: Their structure, growth, and action*. Boston: Houghton Mifflin.

Cavallera, G., & Giudici, S. (2008). Morningness and eveningness personality: A survey in literature from 1995 up till 2006. *Personality and Individual Differences*, *44*, 3–21.

CBC News. (2013, September 13). Edmonton mom found not criminally responsible for drowning son. Retrieved from www.cbc.ca/news/canada/edmonton

Ceci, S. J. (1991). How much does schooling influence general intelligence and its cognitive components? A reassessment of the evidence. *Developmental Psychology*, *27*, 703–722.

Ceci, S. J. (1999). The suggestibility of children's memory. *Annual Review of Psychology*, *50*, 419–439.

Ceci, S. J., & Williams, W. M. (1997). Schooling, intelligence, and income. *American Psychologist*, *52*, 1051–1058.

Centers for Disease Control and Prevention. (2002). Annual smoking-attributable mortality, years of potential life lost, and productivity

losses—United States, 1995–1999. *Morbidity and Mortality Weekly Report*, *51*, 300–303.

Centers for Disease Control and Prevention. (2010).Youth risk behavior surveillance—United States, 2009. *Morbidity and Mortality Weekly Report*, *59*(No. SS-5). Retrieved from www.cdc.gov/mmwr/pdf/ss/ss5905.pdf

Centers for Disease Control and Prevention. (2018). Data & statistics on autism spectrum disorder. Retrieved from www.cdc.gov/ncbddd/autism/data.html

Centers for Disease Control and Prevention. (2019). Measles Cases and Outbreaks. Retrieved from www.cdc.gov/measles/cases-outbreaks.html

Centers for Disease Control. (2019). National Violent Death Reporting System. Data retrieved from https://wisqars.cdc.gov:8443/nvdrs/nvdrsDisplay.jsp

Cepeda, N. N., Pashler, H., Vul, E., et al. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*, *132*, 354–380.

Certain, L. K., & Kahn, R. S. (2003). Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics*, *109*, 634–642.

Cesario, J. (2014). Priming, replication, and the hardest science. *Perspectives on Psychological Science*, *9*, 40–48.

Chabris, C. F., Weinberger, A., Fontaine, M., & Simons, D. J. (2011). You do not talk about Fight Club if you do not notice Fight Club: Inattentional blindness for a simulated real-world assault. *i-Perception*, *2*, 150–153.

Chadwick, P. K. (2014). Peer-professional first person account: Before psychosis —schizoid personality from the inside. *Schizophrenia Bulletin*, *40*, 483–486.

Chaiken, S., & Trope, Y. (1999). *Dual-process theories in social psychology*. New York: Guilford Press.

Chambers, R., Chuen Yee Lo, B., & Allen, N. B. (2008). The impact of intensive mindfulness training on attentional control, cognitive style, and affect. *Cognitive Therapy and Research*, *32*, 303–322.

Chambers, R. A., & Potenza, M. N. (2003). Neurodevelopment, impulsivity, and adolescent gambling. *Journal of Gambling Studies*, *19*, 53–84.

Chambers, R. A., Taylor, J. R., & Potenza, M. N. (2003). Developmental neurocircuitry of motivation in adolescence: A critical period of addiction vulnerability. *The American Journal of Psychiatry*, *160*, 1041–1052.

Chambless, D., & Ollendick, T. (2001). Empirically supported psychological interventions: Controversies and evidence. *Annual Review of Psychology*, *52*, 685–716.

Champagne, F. A. (2010). Epigenetic influence of social experiences across the lifespan. *Developmental Psychobiology*, *52*, 299–311.

Champagne, F. A., Francis, D. D., Mar, A. & Meaney, M. J. (2003). Variations in maternal care in the rat as a mediating influence for the effects of environment on development. *Physiology and Behavior*, *79*, 359–371.

Chan, B. L., Witt, R., Charrow, A. P., Magee, A., Howard, R., Pasquina, P. F., & Heilman, K. M. (2007). Mirror therapy and phantom limb pain. *New England Journal of Medicine*, *357*, 2206–2207.

Chan, Y.-C., Chou, T.-L., Chen, H.-C., Yeh, Y.-C., & Lavallee, J. P. (2013). Towards a neural circuit model of verbal humor processing: An fMRI study of the neural substrates of incongruity detection and resolution. *NeuroImage*, *66*, 169–176.

Chang, A.-M., Aeschbach, D., Duffy, J. F., & Czeisler, C. A. (2015). Evening use of light-emitting eReaders negatively affects sleep, circadian timing, and next-morning alertness. *Proceedings of the National Academy of Science of the United States of America*, *112*, 1232–1237.

Chang, Y., & Brickman, P. (2018). When group work doesn't work: Insights from students. *CBE—Life Sciences Education*, *17*, 1–17.

Chang, Y., & Wang, S. J. (2010). Hypericin, the active component of St. John's wort, inhibits glutamate release in the rat cerbrocortical synaptosomes via a mitogen-activated protein kinase-dependent pathway. *European Journal of Pharmacology*, *634*, 53–61.

Changizi, M. (2009). *The vision revolution*. Dallas, TX: Benbella Books.

Chapman, H. A., Kim, D. A., Susskind, J. M., & Anderson, A. K. (2009). In bad taste: Evidence for the oral origins of moral disgust. *Science*, *323*, 1222–1226.

Chaput, J.-P., Wong, S. L., & Michaud, I. (2017). Duration and quality of sleep among Canadians aged 18 to 79. *Statistics Canada*, Catalogue no. 82-003–x.

Charles, S. T., & Carstensen, L. L. (2009). Social and emotional aging. *Annual Review of Psychology*, *61*, 383–409.

Charles, S. T., Mather, M., & Carstensen, L. L. (2003). Focusing on the positive: Age differences in memory for positive, negative, and neutral stimuli. *Journal of Experimental Psychology*, *85*, 163–178.

Charness, N. (1981). Search in chess: Age and skill differences. *Journal of Experimental Psychology: Human Perception and Performance*, *7*, 467–476.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology*, *76*, 893–910.

Chase, P. G., & Dibble, H. L. (1987). Middle Paleolithic symbolism: A review of current evidence and interpretations. *Journal of Anthropological Archaeology*, *6*, 263–296.

Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive Psychology*, *4*, 55–81.

Chaudhari, N., Landin, A. M., & Roper, S. D. (2000). A metabotropic glutamate receptor variant functions as a taste receptor. *Nature Neuroscience*, *3*, 113–119.

Cheesman, J., & Merikle, P. M. (1986). Distinguishing conscious from unconscious perceptual processes. *Canadian Journal of Psychology*, *40*, 343–367.

Chen, I., Vorona, R., Chiu, R., & Ware, J. (2008). A survey of subjective sleepiness and consequences in attending physicians. *Behavioral Sleep Medicine*, *6*, 1–15.

Chen, J. L., Penhune, V. B., & Zatorre, R. J. (2008). Listening to musical rhythms recruits motor regions of the brain. *Cerebral Cortex*, *18*, 2844–2854.

Chen, K. W., Berger, C. C., Manheimer, E., Forde, D., Magidson, J., ... Lejuez, C. W. (2012). Meditative therapies for reducing anxiety: A systematic review and meta-analysis of randomized controlled trials. *Depression & Anxiety*, *29*, 545–562.

Chen, S. C. (1937). Social modification of the activity of ants in nest-building. *Physiological Zoology*, *10*, 420–436.

Chen, Z., & Cowan, N. (2005). Chunk limits and length limits in immediate recall: A reconciliation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *31*, 1235–1249.

Cheng, H., & Riffe, D. (2008). Attention, perception, and perceived effects: Negative political advertising in a battleground state of the 2004 presidential election. *Mass Communication & Society*, *11*, 177–196.

Chentsova-Dutton, Y. E., & Tsai, J. L. (2007). Gender differences in emotional responding among European Americans and Hmong Americans. *Cognition and Emotion*, *21*, 162–181.

Cheung, B. Y., Chudek, M., & Heine, S. J. (2011). Evidence for a sensitive period for acculturation: Younger immigrants report acculturating at a faster rate. *Psychological Science*, *22*, 147–152.

Cheung, F. M., Leung, K., Fan, R. M., Song, W., Zhang J.-X., & Zhang J.-P. (1996). Development of the Chinese Personality Assessment Inventory. *Journal of Cross-Cultural Psychology*, *27*, 181–199.

Cheung, R., O'Donnell, S., Madi, W., & Goldner, E. M. (2017). Factors associated with delayed diagnosis of mood and/or anxiety disorders. *Public Health Agency of Canada reports and publications*, *7*, 1–12. Retrieved from www.canada.ca/en/public-health/services/reports-publications/health-promotion-chronic-disease-prevention-canada-research-policy-practice/vol-37-no-5-2017/factors-associated-delayed-diagnosis-mood-anxiety-disorders.html

Chirkov, V. I., Ryan, R. M., Kim, Y., & Kaplan, U. (2003). Differentiating autonomy from individualism and independence: A self-determination theory perspective on internalization of cultural orientations and well-being. *Journal of Personality and Social Psychology*, *84*, 97–110.

Chirkov, V. I., Safdar, S., de Guzman, J., & Playfoird, K. (2008). Further examining the role motivation to study abroad plays in the adaptation of intentional students in Canada. *International Journal of Intercultural Relations*, *32*, 427–440.

Chirkov, V. I., Vansteenkiste, M., Tao, R., & Lynch, M. (2007). The role of motivation to study abroad in the adaptation of international students: A self-determination theory approach. *International Journal of Intercultural Relations*, *31*, 199–222.

Chistyakov, A.V., Kaplan, B., Rubicheck, O., Kreinin, I., Koren, D., ... Klein, E. (2005). Antidepressant effects of different schedules of repetitive transcranial magnetic stimulation vs. clomipramine in patients with major depressions: Relationship to changes in cortical

excitability. *International Journal of Neuropsychopharmacology*, *8*, 223–233.

Choi, I., Nisbett, R. E., & Norenzayan, A. (1999). Causal attribution across cultures: Variation and universality. *Psychological Bulletin*, *125*, 47–63.

Choi, Y., Shamosh, N. A., Cho, S., DeYoung, C. G., Lee, M., ... Lee, K. (2008). Multiple bases of human intelligence revealed by cortical thickness and neural activation. *The Journal of Neuroscience*, *28*, 10323–10329.

Chopra, I. C., & Chopra, R.W. (1957). The use of cannabis drugs in India. *Bulletin of Narcotics*, *9*, 4–29.

Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L., & McCarthy, C. A. (2004). Early television exposure and subsequent attentional problems in children. *Pediatrics*, *113*, 708–713.

Christakis, N. A., & Fowler, J. H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine*, *357*, 370–379.

Christakis, N. A., & Fowler, J. H. (2008). The collective dynamics of smoking in a large social network. *New England Journal of Medicine*, *358*, 2249–2258.

Christensen, C., Silberberg, A., Hursh, S., Huntsberry, M., & Riley, A. (2008). Essential value of cocaine and food in rats: Tests of the exponential model of demand. *Psychopharmacology*, *198*, 221–229.

Christensen, M. A., Bettencourt, L., Kaye, L., Moturu, S. T., Nguyen, K. T., Olgin, J. E., … Marcus, G. M. (2016). Direct measurements of smartphone screen-time: Relationships with demographics and sleep. *PLoS ONE*, *11*, 1–14.

Christian, K. M., Song, H., & Ming, G. (2014). Functions and Dysfunctions of Adult Hippocampal Neurogenesis. *Annual Review of Neuroscience*, *37*, 243–262.

Christiansen, H., Hirsch, O., Albrecht, B., & Chavanon, M. (2019). Attention-Deficit/Hyperactivity Disorder (ADHD) and emotion regulation over the life span. *Current Psychiatry Reports*, *21*, 16–18.

Christie, R., & Geis, F. L. (1970). *Studies in Machiavellianism*. New York: Academic Press.

Christoff, K., Gordon, A. M., Smallwood, J., Smith, R., & Schooler, J. W. (2009). Experience sampling during fMRI reveals default network and executive systems contributions to mind wandering. *Proceedings of the National Academy of Science USA*, *106*, 8719–8724.

Chung, S., & Herrnstein, R. J. (1967). Choice and delay of reinforcement. *Journal of Experimental Analysis of Behavior*, *10*, 67–74.

Church, T. A. (2010). Culture and personality: Toward an integrated cultural trait psychology. *Journal of Personality*, *68*, 651–703.

Cialdini, R. B. (2000). *Persuasion: Influence and practice* (4th ed.). New York: Allyn & Bacon.

Cialdini, R. B. (2001). Harnessing the science of persuasion. *Harvard Business Review*, *79*, 72–81.

Cialdini, R. B., & Goldstein, N. J. (2004). Social influence: Compliance and conformity. *Annual Review of Psychology*, *55*, 591–621.

Cialdini, R. B., Vincent, J. E., Lewis, S. K., Catalan, J., Wheeler, D., & Darby, B. (1975). Reciprocal concessions procedure for inducing compliance: The door-in-the-face technique. *Journal of Personality and Social Psychology*, *31*, 206–215.

Cianci A. M., Klein H. J., & Seijts G. H. (2010). The effect of negative feedback on tension and subsequent performance: The main and interactive effects of goal content and conscientiousness. *Journal of Applied Psychology*, *95*, 618–630.

Claassen, R. L., & Ensley, J. (2016). Motivated reasoning and yard-sign-stealing partisans: Mine is a likable rogue, yours is a degenerate criminal. *Political Behavior*, *38*, 317–335.

Clancy, S. A. (2005). *Abducted: How people come to believe they were kidnapped by aliens*. Cambridge, MA: Harvard University Press.

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, *3*, 149–210.

Clark, L. A. (2007). Assessment and diagnosis of personality disorder: Perennial issues and an emerging reconceptualization. *Annual Review of Psychology*, *58*, 227–257.

Clarke, D., Pulford, J., Bellringer, M., Abbott, M., & Hodgins, D. C. (2012). An exploratory study of problem gambling on casino versus non-casino electronic gaming machines. *International Journal of Mental Health and Addiction*, *10*, 107–121.

Clopton, N. A., & Sorell, G. T. (1993). Gender differences in moral reasoning: Stable or Situational? *Psychology of Women Quarterly*, *17*, 85–101.

Coane, J. H., & Balota, D. A. (2009). Priming the holiday spirit: Persistent activation due to extraexperimental experiences. *Psychonomic Bulletin & Review*, *16*, 1124–1128.

Cohen, B., Guttmann, D., & Lazar, A. (1998). The willingness to seek help: A cross-national comparison. *Cross-Cultural Research: The Journal of Comparative Social Science*, *32*, 342–357.

Cohen, F., Ogilvie, D. M., Solomon, S., Greenberg, J., & Pyszczynski, T. (2005). American roulette: The effect of reminders of death on support for George W. Bush in the 2004 presidential election. *Analyses of Social Issues and Public Policy (ASAP)*, *5*, 177–187.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Cohen, J. (1994). The earth is round (p. *American Psychologist*, *49*, 997–1003.

Cohen, J. (2018). What now for human genome editing? *Science*, *362*, 1090–1092.

Cohen, N. J., Eichenbaum, H., Deacedo, B. S., & Corkin, S. (1985). Different memory systems underlying acquisition of procedural and declarative knowledge. In D. S. Olton, E. Gamzu, & S. Corkin (Eds.), *Memory dysfunctions: An integration of animal and human research from preclinical and clinical perspectives* (pp. 54–71). New York: New York Academy of Sciences.

Coid, J., & Ullrich, S. (2010). Antisocial personality disorder is on a continuum with psychopathy. *Comprehensive Psychiatry*, *51*, 426–433.

Cojan, Y., Piguet, C., & Vuilleumier, P. (2015). What makes your brain suggestible? Hypnotizability is associated with differential brain activity during attention outside of hypnosis. *NeuroImage*, *117*, 367–374.

Cole, J., Watkins, C., & Kleine, D. (2016). Health advice from internet discussion forums: How bad is dangerous? *Journal of Medical Internet Research*, *18*, e4.

Cole, S., Korin, Y., Fahey, J., & Zack, J. (1998). Norepinephrine accelerates HIV replication via protein kinase A–dependent effects on cytokine production. *Journal of Immunology*, *161*, 610–616.

Coles, N. A., Larsen, J. T., & Lench, H. C. (2019). A meta-analysis of the facial feedback literature: Effects of facial feedback on emotional experience are small and variable. *Psychological Bulletin*, *145*, 610–651.

Collins, A. (1988). *In the sleep room: The story of CIA brainwashing experiments in Canada*. Toronto: Key Porter Books.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological Review*, *82*, 407–428.

Collins, B. M. (2012). *Ontario's leucotomy program: The roles of patient, physician, and profession*. Master's thesis, Department of Psychology, University of Calgary.

Colonna-Pydyn, C., Gjesfjeld, C., & Greeno, C. (2007). The factor structure of the Barriers to Treatment Participation Scale (BTPS): Implications for future barriers scale development. *Administration and Policy in Mental Health and Mental Health Services Research*, *34*, 563–569.

Colwill, R. M., & Rescorla, R. A. (1985). Postconditioning devaluation of a reinforce affects instrumental responding. *Journal of Experimental Psychology: Animal Behavior Processes*, *11*, 120–132.

Colwill, R. M., & Rescorla, R. A. (1990). Effect of reinforce devaluation on discriminative control of instrumental behaviour. *Journal of Experimental Psychology*, *16*, 40–47.

Comings, D. E., & Blum, K. (2000). Reward deficiency syndrome: Genetic aspects of behavioural disorders. *Progress in Brain Research*, *126*, 325–341.

Compton, J. A., & Pfau, M. W. (2005). *Inoculation theory of resistance to influence at maturity: Recent progress in theory development and application and suggestions for future research* (pp. 97–145). Mahwah, NJ: Lawrence Erlbaum Associates.

Conde-Agudelo, A., Belizan, J. M., & Diaz-Rossello, J. (2011). Kangaroo mother care to reduce morbidity and mortality in low birthweight infants. *Cochrane Database of Systematic Reviews*, *3*.

Condon, P. (2019). Meditation in context: Factors that facilitate prosocial behavior. *Current Opinion in Psychology*, *28*, 15–19.

Connelly, M. (2000, February 29). Poll finds that half in state disagree with Diallo verdict. *New York Times*. Retrieved from https://www.nytimes.com/2000/02/29/nyregion/poll-finds-that-half-in-state-disagree-with-diallo-verdict.html

Conway, M., & Ross, M. (1984). Getting what you want by revising what you had. *Journal of Personality and Social Psychology*, *47*, 738–748.

Cook, E. W., Hodes, R. L., & Lang, P. J. (1986). Preparedness and phobia: Effects of stimulus content on human visceral conditioning. *Journal of Abnormal Psychology*, *95*, 195–207.

Cook, I. A., Warren, C., Pajot, S. K., Schairer, D., & Leuchter, A. F. (2011). Regional brain activation with advertising images. *Journal of Neuroscience, Psychology, and Economics*, *4*, 147–160.

Coombs, R. H. (1991). Marital status and personal wellbeing: A literature review. *Family Relations*, *40*, 97–102.

Cooney, R. E., Joormann, J., Eugène, F., Dennis, E. L., & Gotlib, I. H. (2010). Neural correlates of rumination in depression. *Cognitive, Affective, and Behavioral Neuroscience*, *10*, 470–478.

Cooper, A. (1998). Sexuality and the internet: Surfing into the new millennium. *Cyberpsychology and Behavior*, *1*, 187–193.

Cooper, H. M., Charlton, K., Valentine, J. C., & Muhlenbruck, L. (2000). Making the most of summer school: A meta-analytic and narrative review. *Monographs of the Society for Research in Child Development*, *65*(1, Serial No. 260).

Cooper, S. J. (2005). Donald O. Hebb's synapse and learning rule: A history and commentary. *Neuroscience and Biobehavioral Reviews*, *28*, 851–874.

Corazzol, M., Lio, G., Lefevre, A., Deiana, G., Tell, L., André-Obadia, N., ... Sirigu, A. (2017). Restoring consciousness with vagus nerve stimulation. *Current Biology*, *27*, R994–R996.

Corballis, M. C. (1993). *The lopsided ape*. Oxford, UK: Oxford University Press.

Cordner, G., & Shain, C. (2011). The changing landscape of police education and training. *Police Practice and Research*, *12*, 281–285.

Coren, S. (1996a). Daylight savings time and traffic accidents. *New England Journal of Medicine*, *334*, 924.

Coren, S. (1996b). Accidental death and the shift to daylight savings time. *Perceptual and Motor Skills*, *83*, 921–922.

Corkin, S. (2002). What's new with the amnesic patient H.M.? *Nature Reviews Neuroscience*, *3*, 153–160.

Corkum, P., Davidson, F. D., Tan-MacNeil, K., & Weiss, S. K. (2014). Sleep in children with neurodevelopmental disorders: A focus on insomnia in children with ADHD and ASD. *Sleep Medical Clinics*, *9*, 149–168.

Correll, J., Park, B., Judd, C. M., & Wittenbrink, B. (2007). The influence of stereotypes on decisions to shoot. *European Journal of Social Psychology*, *37*(6), 1102–1117.

Correll, J., Urland, G. R., & Ito, T. A. (2006). Event-related potentials and the decision to shoot: The role of threat perception and cognitive control. *Journal of Experimental Social Psychology*, *42*, 120–128.

Corrigan, P. (2004). How stigma interferes with mental health care. *American Psychologist*, *59*, 614–625.

Corti, M., Patten, C., & Triggs, W. (2012). Repetitive transcranial magnetic stimulation of motor cortex after stroke: A focused review. *American Journal of Physical Medicine and Rehabilitation*, *91*, 254–270.

Cosgrove, G. R., & Rauch, S. L. (2003). Stereotactic cingulotomy. *Neurosurgery Clinics of North America*, *13*, 225–235.

Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition*, *106*, 59–86.

Cote, K. A., Milner, C. E., Osip, S. L., Baker, M. L., & Cuthbert, B. P. (2008). Physiological arousal and attention during a week of continuous sleep restriction. *Physiology & Behavior*, *95*, 353–364.

Cotman, C. W., & Berchtold, N. C. (2002). Exercise: A behavioral intervention to enhance brain health and plasticity. *Trends in Neuroscience*, *26*, 295–301.

Cowan, C. P., & Cowan, P. A. (1995). Interventions to ease the transition to parenthood: Why they are needed and what they can do. *Family Relations*, *44*, 412–423.

Cowan, C. P., & Cowan, P. A. (2000). *When partners become parents: The big life change for couples*. Mahwah, NJ: Lawrence Erlbaum Associates.

Cowan, N. (2008). What are the differences between long-term, short-term, and working memory? *Progress in Brain Research*, *169*, 323–338.

Cowan, N., Lichty, W., & Grove, T. R. (1990). Properties of memory for unattended spoken syllables. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *16*, 258–269.

Cowan, R. L., Roberts, D. M., & Joers, J. M. (2008). Neuroimaging in humans MDMA (Ecstasy) users: A cortical model. *Annals of the New York Academy of Sciences*, *1139*, 291–298.

Cox, C., Arndt, J., Pyszczynksi, T., Greenberg, J., Abdollahi, A., & Solomon, S. (2008). Terror management and adults′ attachment to their parents: The safe haven remains. *Journal of Personality and Social Psychology*, *94*, 696–717.

Craig, I., & Plomin, R. (2006). Quantitative trait loci for IQ and other complex traits: Single-nucleotide polymorphism genotyping using pooled DNA and microarrays. *Genes, Brain and Behavior*, *5*(suppl 1), 32–37.

Craig, L. A., Hong, N. S., & McDonald, R. J. (2011). Revisiting the cholinergic hypothesis in the development of Alzheimer's disease. *Neuroscience and Biobehavioral Reviews*, *35*, 1397–1409.

Craig, M. C., Catani, M., Deeley, Q., Latham, R., Daly, E., & Kanaan, R. (2009). Altered connections on the road to psychopathy. *Molecular Psychiatry*, *14*, 946–953.

Craik, F., & Lockhart, R. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning & Verbal Behavior*, *11*, 671–684.

Craik, F., & Tulving, E. (1975). Depth of processing and the retention of words in episodic memory. *Journal of Experimental Psychology: General*, *104*, 268–294.

Craik, F., & Watkins, M. (1973).The role of rehearsal in short-term memory. *Journal of Verbal Learning & Verbal Behavior*, *12*, 599–607.

Crane, C., & Williams, J. M. G. (2010). Factors associated with attrition from mindfulness based cognitive therapy for suicidal depression. *Mindfulness*, *1*, 10–20.

Cranford, R. (2005). Facts, lies, and videotapes: The permanent vegetative state and the sad case of Terri Schiavo. *The Journal of Law, Medicine & Ethics*, *33*, 363–371.

Craske, M., Edlund, M., Sullivan, G., Sherbourne, C., Stein, M., & Bystritsky, A. (2005). Perceived unmet need for mental health treatment and barriers to care among patients with panic disorder. *Psychiatric Services*, *56*, 988–994.

Crean, R. D., Crane, N. A., & Mason, B. J. (2011). An evidence-based review of acute and long-term effects of cannabis use on executive cognitive functions. *Journal of Addictive Medicine*, *5*, 1–8.

Crick, F. (1994). *The astonishing hypothesis*. London, UK: Simon & Schuster Ltd.

Critchley, H., Daly, E., Phillips, M., Brammer, M., Bullmore, E., Williams, S., et al. (2000). Explicit and implicit neural mechanisms for processing of social information from facial expressions: A functional magnetic resonance imaging study. *Human Brain Mapping*, *9*, 93–105.

Crompton, S. (2011). What's stressing the stressed? Main sources of stress among workers. *Components of Statistics Canada Catalogue No 11-000-X: Canadian Social Trends*. Ottawa, ON: Statistics Canada.

Cruse, D., Chennu, S., Chatelle, C., Bekinschtein, T. A., Fernandez-Espejo, D., Pickard, J. D., et al. (2011). Bedside detection of awareness in the vegetative state: A cohort study. *The Lancet*, *378*, 2088–2094.

Cryan, J. F., Markou, A., & Lucki, I. (2002). Assessing antidepressant activity in rodents: Recent developments and future needs. *Trends*

in Pharmacological Sciences, *23*, 238–245.

Csibra, G., Davis, G., Spratling, M. W., & Johnson, M. H. (2000). Gamma oscillations and object processing in the infant brain. *Science*, *290*, 1582–1585.

Cuddy, A. (2019). Your body language may shape who you are [video]. TED Talk. Retrieved from www.youtube.com/watch?v=Ks-_Mh1QhMc.

Cukor, J., Spitalnick, J., Difede, J., Rizzo, A., & Rothbaum, B. O. (2009). Emerging treatments for PTSD. *Clinical Psychology Review*, *29*, 715–726.

Cunningham, W. A., Johnson, M. K., Raye, C. L., Gatenby, J. C., Gore, J. C., & Banaji, M. R. (2004). Separable neural components in the processing of Black and White faces. *Psychological Science*, *15*, 806–813.

Curran, H. V., & Travill, R. A. (1997). Mood and cognitive effects of ±3,4-methylenedioxymethamphetamine (MDMA, "ecstasy"): week-end "high" followed by mid-week low. *Addiction*, *92*, 821–831.

Cutrona, C., Wallace, G., & Wesner, K. (2006). Neighborhood characteristics and depression: An examination of stress processes. *Current Directions in Psychological Science*, *15*(4), 188–192.

Cytowic, R. E. (1993). *The man who tasted shapes*. New York: G. P. Putnam's Sons.

D'Argembeau, A., Raffard, S., & Van der Linden, M. (2008). Remembering the past and imaging the future in schizophrenia. *Journal of Abnormal Psychology*, *117*, 247–251.

D'Astous, M., Cottin, S., Roy, M., Picard, C., & Cantin, L. (2013). Bilateral stereotactic anterior capsulotomy for obsessive-compulsive disorder: long-term follow-up. *Journal of Neurology, Neurosurgery, and Psychiatry*, *84*, 1208–1213.

Dabbs, J. M., & Hargrove, M. F. (1997). Age, testosterone, and behavior among female prison inmates. *Psychosomatic Medicine*, *59*, 477–480.

Dabbs, J. M., Carr, T. S., Frady, R. L., & Riad, J. K. (1995). Testosterone, crime, and misbehavior among 692 male prison inmates. *Personality and Individuals Differences*, *18*, 627–633.

Dagher, A. (2012). Functional brain imaging of appetite. *Trends in Endocrinology and Metabolism*, *23*, 250–260.

Dahl, R. E. (2001). Affect regulation, brain development, and behavioral/emotional health in adolescence. *CNS Spectrums*, *6*, 60–72.

Dal Cin, S., Gibson, B., Zanna, M. P., Shumate, R., & Fong, G. T. (2007). Smoking in the movies, implicit associations of smoking with the

self, and intentions to smoke. *Psychological Science*, *18*, 559–563.

Dallman, M. F., Pecoraro, N., Akana, S. F., La Fleur, S. E., Gomez, F., Houshyar, H., et al. (2003). Chronic stress and obesity: A new view of “comfort food.” *Proceedings of the National Academy of Sciences of the United States of America*, *100*, 11696–11701.

Damasio, A. R. (1994). *Descartes’ error: Emotion, reason, and the human brain*. New York: Putnam Publishing.

Damisch, L., Stoberock, B., & Mussweiler, T. (2010). Keep your fingers crossed! How superstition improves performance. *Psychological Science*, *21*, 1014–1020.

Dani, C., Poggi, C., Romagnoli, C., & Bertini, G. (2009). Survival and major disability rate in infant born at 22–25 weeks of gestation. *Journal of Perinatal Medicine*, *37*, 599–608.

Daniel, T. A., Townsend, K. M., Wang, Y., Martin, D. S., Katz, J. S., & Deshpande, G. (2018). North American football fans show neurofunctional differences in response to violence: Implications for public health and policy. *Frontiers in Public Health*. https://doi.org/10.3389/fpubh.2018.00177

Danner, D. D., Snowdon, D. A., & Friesen, W. V. (2001). Positive emotions in early life and longevity: Findings from the nun study. *Journal of Personality and Social Psychology*, *80*, 804–813.

Dar-Nimrod, I., Rawn, C. D., Lehman, D. R., & Schwartz, B. (2009). The maximization paradox: The costs of seeking alternatives. *Personality and Individual Differences*, *46*, 631–635.

Dargie, E., Blair, K. L., Pukall, C. F., & Coyle, S. M. (2014). Somewhere under the rainbow: Exploring the identities and experiences of trans persons. *The Canadian Journal of Human Sexuality*, *23*, 60–74.

Darley, J. M., & Latané, B. (1968). Bystander intervention in emergencies: Diffusion of responsibility. *Journal of Personality and Social Psychology*, *8*, 377–383.

Darvesh, S., Walsh, R., Kumar, R., Caines, A., Roberts, S., Magee, … Martin E. (2003). Inhibition of human cholinesterases by drugs used to treat Alzheimer disease. *Alzheimer Disease and Associated Disorders*, *17*, 117–126.

Darwin, C. (1871). *The descent of man, and selection in relation to sex*. London, UK: John Murray.

Darwin, C. (1872). *The expression of the emotions in man and animals*. London, UK: John Murray.

Dastoor, S. F., Misch, C. E., & Wang, H. L. (2007). Botulinum toxin (Botox) to enhance facial macroesthetics: A literature review. *Journal of Oral Implantology*, *33*, 164–171.

Davis, B. P., & Knowles, E. S. (1999). A disrupt-then-reframe technique of social influence. *Journal of Personality and Social Psychology*, *76*(2), 192–199.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., et al. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology*, *30*, 91–98.

Davis, C., & Scott-Robertson, L. (2000). A psychological comparison of females with anorexia nervosa and competitive male bodybuilders: Body-shape ideals in the extreme. *Eating Behaviors*, *1*, 33–46.

Davis, D., & Loftus, E. F. (2009) Expectancies, emotion and memory reports of visual events. In J. R. Brockmole (Ed.), *The Visual World in Memory* (pp. 178–214). New York: Psychology Press.

Dawson, D., & Reid, K. (1997). Fatigue, alcohol and performance impairment. *Nature*, *388*, 235.

Day, J. J., & Sweatt, J. D. (2011). Epigenetic mechanisms in cognition. *Neuron*, *70*, 813–829.

de Araujo, I. E., & Rolls, E. T. (2004). Representation in the human brain of food texture and oral fat. *Journal of Neuroscience*, *24*, 3086–3093.

de Gelder, B., & Hadjikhani, N. (2006). Non-conscious recognition of emotional body language. *Neuro Report*, *17*, 583–586.

de Jonghe, F., Kool, S., van Aalst, G., Dekker J., & Peen J. (2001). Combining psychotherapy and antidepressants in the treatment of depression. *Journal of Affective Disorders*, *64*, 217–229.

De Los Reyes, A., & Kazdin, A. (2008). When the evidence says, "yes, no, and maybe so": Attending to and interpreting inconsistent findings among evidence-based interventions. *Current Directions in Psychological Science*, *17*, 47–51.

De Marchis, G. M., Burgi, S., Kientsch, U., & Honegger, U. E. (2006). Vitamin E reduces antidepressant-related beta-adrenoceptor down-regulation in cultured cells. Comparable effects on St. John's wort and tricyclic antidepressant treatment. *Planta Medica*, *72*, 1436–1437.

De Vadder, F., Grasset, E., Holm, L. M., Karsenty, G., Macpherson, A. J., Olofsson, L. E., & Bäckhed, F. (2018). Gut microbiota regulates maturation of the adult enteric nervous system via enteric serotonin networks. *Proceedings of the National Academy of Sciences*, *115*, 6458–6463.

de Visser, R.O., & McDonnell, E.J. (2012). 'That's OK. He's a guy': a mixed-methods study of gender double-standards for alcohol use. *Psychology & Health*, *27*, 618–639.

de Vries, R. E., & van Kampen, D. (2010). The HEXACO and 5DPT models of personality: A comparison and their relationships with psychopathy, egoism, pretentiousness, immorality and Machiavelliansim. *Journal of Personality Disorders*, *24*, 244–257.

de Waele, C., Baudonniere, P. M., Lepecq, J. C., Tran Ba Huy, P., & Vidal P. P. (2001). Vestibular projections in the human cortex. *Experimental Brain Research*, *141*, 541–551.

Deary, I. J., & Stough, C. (1996). Intelligence and inspection time: Achievements, prospects, and problems. *American Psychologist*, *51*, 599–608.

Deary, I. J., Penke, L., & Johnson, W. (2010). The neuroscience of human intelligence differences. *Nature Reviews Neuroscience*, *11*, 201–211.

Deary, I., Strand, S., Smith, P., & Fernandes, C. (2007). Intelligence and educational achievement. *Intelligence*, *35*, 13–21.

DeCasper, A. J., & Prescott, P. A. (1984). Human newborns' perception of male voices: Preference, discrimination, and reinforcing value. *Developmental Psychobiology*, *17*, 481–491.

DeCasper, A. J., & Spence, M. J. (1986). Prenatal maternal speech influences newborns' perception of speech sounds. *Infant Behavior and Development*, *9*, 133–150.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, *18*, 105–115.

Deci, E. L., & Vansteenkiste, M. (2004). Self-determination theory of basic need satisfaction: Understanding human development in positive psychology. *Risershe di Psicologia*, *27*, 23–40.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality*, *62*, 119–142.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, *125*, 627–668.

Deese, J. (1959). On the prediction of occurrence of particular verbal intrusions in immediate recall. *Journal of Experimental Psychology*, *58*, 17–22.

Deese, J., & Kaufman, R. A. (1957). Serial effects in recall of unorganized and sequentially organized verbal material. *Journal of Experimental Psychology*, *54*, 180–187.

Degardin, A., Devos, D., Defebvre, L., Destée, A., Plomhause, L., … Devanne, H. (2012). Effect of intermittent theta-burst stimulation on akinesia and sensorimotor integration in patients with Parkinson's disease. *European Journal of Neuroscience*, *36*, 2669–2678.

Delaney, P. F., Verkoeijen, P. J., & Spirgel, A. (2010). Spacing and testing effects: A deeply critical, lengthy, and at times discursive review of the literature. *The Psychology of Learning and Motivation: Advances in Research and Theory*, *53*, 63–147.

Delgado, J. M. R., & Anand, B. K. (1952). Increase of food intake induced by electrical stimulation of the lateral hypothalamus. *American Journal of Physiology*, *172*, 162–168.

DeLoache, J. S. (1995). Early understanding and use of symbols: The model model. *Current Directions in Psychological Science*, *4*, 109–113.

DeLoache, J. S., Uttal, D. H., & Rosengren, K. S. (2004). Scale errors offer evidence for a perception–action dissociation early in life. *Science*, *304*, 1027–1029.

DeLongis, A., & Holtzman, S. (2005). Coping in context: The role of stress, social support, and personality in coping. *Journal of Personality*, *73*, 1633–1656.

Dempster, F. N. (1988). The spacing effect: A case study of the failure to apply the results of psychological research. *American Psychologist*, *43*, 627–634.

Dennis, N. A., Bowman, C. R., & Vandekar, S. N. (2012). True and phantom recollection: An fMRI investigation of similar and distinct neural correlates and connectivity. *NeuroImage*, *59*, 2982–2993.

Denny, B. T., Fan, J., Liu, X., Guerreri, S., Mayson, S. J., ...& Koenigsberg, H. W. (2016). Brain structural anomalies in borderline and avoidant personality disorder patients and their associations with disorder-specific symptoms. *Journal of Affective Disorders*, *200*, 266–274.

Denny, B. T., Fan, J., Liu, X., Ochsner, K. N., Guerreri, S., Mayson, S. J., ... Koenigsberg, H. W. (2015). Elevated amygdala activity during reappraisal anticipation predicts anxiety in avoidant personality disorder. *Journal of Affective Disorders*, *172*, 1–7.

Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: Dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, *22*, 491–569.

DeRubeis, R., & Crits-Christoph, P. (1998). Empirically supported individual and group psychological treatments for adult mental disorders. *Journal of Consulting and Clinical Psychology*, *66*, 37–52.

Desroches, A. S., & Joanisse, M. (2009). Dyslexia. In E. Goldstein (Ed.), *Encyclopedia of perception* (pp. 371–373). Thousand Oaks, CA: Sage Publications.

Desroches, A. S., Cone, N. E., Bolger, D. J., Bitan, T., Burman, D. D., & Booth, J. R. (2010). Children with reading difficulties show differences in brain regions associated with orthographic processing during spoken language processing. *Brain Research*, *1356*, 73–84.

Deschner, T., Heistermann, M., Hodges, K., & Boesch, C. (2004). Female sexual swelling size, timing of ovulation, and male behavior in wild

West African chimpanzees. *Hormones and Behavior*, *46*, 204–215.

DeYoung, C. G., Hirsh, J. B., Shane, M. S., Papademetris, X., Rajeevan, N., & Gray, J. R. (2010). Testing predictions from personality neuroscience: Brain structure and the Big Five. *Psychological Science*, *21*, 820–828.

Di Chiara, G., & Imperato, A. (1988). Drugs abused by humans preferentially increase synaptic dopamine concentrations in the mesolimbic system of freely moving rats. *Proceedings of the National Academy of Science USA*, *85*, 5274–5279.

di Pellegrino, G., Fadiga, I., Fogassi, I., Gallese, V., & Rizzolatti, G. (1992). Understanding motor events: A neurophysiological study. *Experimental Brain Research*, *91*, 176–180.

Diamond, M. C., Krech, D., & Rosenzweig, M. R. (1964). The effects of an enriched environment on the histology of the rat cerebral cortex. *Journal of Comparative Neurology*, *123*, 111–120.

Diamond, M. C., Scheibel, A. B., Murphy, G. M. Jr., & Harvey, T. (1985). On the brain of a scientist: Albert Einstein. *Experimental Neurology*, *88*, 198–204.

Diana, R. A., Yonelinas, A. P., & Ranganath, C. (2007). Imaging recollection and familiarity in the medial temporal lobe: A three-component model. *Trends in Cognitive Sciences*, *11*, 379–386.

Diaz, J. H. (2004). The global epidemiology, syndromic classification, management, and prevention of spider bites. *American Journal of Tropical Medicine and Hygiene*, *71*, 239–250.

Dick, D. M. (2007). Identification of genes influencing a spectrum of externalizing psychopathology. *Current Directions in Psychological Science*, *16*, 331–335.

Digdon, N., Powell, R. A., & Harris, B. (2014). Little Albert's alleged neurological impairment: Watson, Rayner and historical revision. *History of Psychology*, *17*, 313–324.

Dilworth-Bart, J. E., & Moore, C. F. (2006). Mercy mercy me: Social injustice and the prevention of environmental pollutant exposures among ethnic minority and poor children. *Child Development*, *77*, 247–265.

Dingemanse, N. J., Both, C., Drent, P. J., & Tinbergen, J. M. (2004). Fitness consequences in a fluctuating environment. *Proceedings of the Royal Society of London, Series B*, *271*, 847–852.

Dinges, D. F. (2006). The state of sleep deprivation: From functional biology to functional consequences. *Sleep Medicine Review*, *10*, 303–305.

Dinges, D. F., Maislin, G., Brewster, R. M., Krueger, G. P., & Carroll, R. J. (2005). Pilot test of fatigue management technologies. *Journal of the Transportation Research Board No. 1922, Transportation Research Board of the National Academies, Washington, DC*, 175–182. Retrieved

from www.med.upenn.edu/uep/user_documents/Dingesetal.–TRBProceedingspaper05-1234.pdf

Dingledine, R., Borges, K., Bowie, D., & Traynelis, S. F. (1999). The glutamate receptor ion channels. *Pharmacology Review*, *51*, 7–61.

DiPaola, S., Riebe, C., & Enns, J. T. (2011). Rembrandt's textural agency: A shared perspective in visual art and science. *Leonardo*, *43*, 145–151.

Ditzen, B., Schaer, M., Gabriel, B., Bodenmann, G., Ehlert, U., & Heinrichs, M. (2009). Intranasal oxytocin increases positive communication and reduces cortisol levels during couple conflict. *Biological Psychiatry*, *65*, 728–731.

Divjak, D., & Arppe, A. (2013). Extracting prototypes from exemplars What can corpus data tell us about concept representation? *Cognitive Linguistics*, *24*, 221–274.

Dixon, M. J., Bub, D. N., & Arguin, M. (1997). The interaction of object form and object meaning in the identification performance of a patient with category specific visual agnosia. *Cognitive Neuropsychology*, *14*, 1085–1130.

Dixon, M. J., Desmarais, G., Goimerac, C., Schweizer, T. A., & Bub, D. N. (2002). The role of premorbid expertise on object identification in category-specific visual agnosia. *Cognitive Neuropsychology*, *19*, 401–419.

Dixon, M. J., Harrigan, K. A., Sandhu, R., Collins, K., & Fugelsang, J. A. (2010). Losses disguised as wins in modern multi-line video slot machines. *Addiction*, *105*, 1819–1824.

Dixon, M. J., Harrigan, K. A., Santesso, D. L., Graydon, C., Fugelsang, J. A., & Collins, K. (2014). The impact of sound in modern multiline video slot machine play. *Journal of Gambling Studies*, *30*, 913–929.

Dixon, M. J., Smilek, D., Cudahy, C., & Merikle, P. M. (2000). Five plus two equals yellow. *Nature*, *406*, 365.

Dixon, P., & Bortolussi, M. (2013). Construction, integration, and mind wandering in reading. *Canadian Journal of Experimental Psychology*, *67*, 1–10.

Dixson, A. F. (1983). Observations on the evolution and behavioural significance of "sexual skin" in female primates. *Advances in the Study of Behavior*, *13*, 63–106.

Dixson, B. J., Dixson, A. F., Bishop, P. J., & Parish, A. (2010). Human physique and sexual attractiveness in men and women: a New Zealand-U.S. comparative study. *Archives of Sexual Behavior*, *39*, 798–806.

Dobkin, P. L. (2008). Mindfulness-based stress reduction: What processes are at work? *Complementary Therapies in Clinical Practice*, *14*, 8–16.

Dolcos, F., LaBar, K. S., & Cabeza, R. (2004). Interaction between the amygdala and the medial temporal lobe memory system predicts better memory for emotional events. *Neuron*, *42*, 855–863.

Domjan, M., & Krause, M. A. (2017). Adaptive specializations and the generality of the laws of classical and instrumental conditioning. In R. Menzel (Ed.), *Learning theory and behavior, Vol. 1 of Learning and memory: A comprehensive reference* 2nd ed. J.H. Byrne (Ed.), pp. 180–201. Oxford, UK: Academic Press.

Domjan, M., Cusato, B., & Krause, M. A. (2004). Learning with arbitrary versus ecological conditioned stimuli: Evidence from sexual conditioning. *Psychonomic Bulletin and Review*, *11*, 232–246.

Donate, A. P. G., Marques, L. M., Lapenta, O. M., Asthana, M. K., Amodio, D., & Boggio, P. S. (2017). Ostracism via virtual chat room —Effects on basic needs, anger and pain. *PLoS ONE*, *12*, e0184215.

Done, D. J., Crow, T. J., Johnstone, E. C., & Sacker, A. (1994). Childhood antecedents of schizophrenia and affective illness: Social adjustment at ages 7 and 11. *British Medical Journal*, *309*, 699–703.

Donnelly, B., Touyz, S., Hay, P., Burton, A., Russell, J., & Caterson, I. (2018). Neuroimaging in bulimia nervosa and binge eating disorder : a systematic review. *Journal of Eating Disorders*, *6*, 3.

Döring, N., Daneback, K., Shaughnessy, K., Grov, C., & Byers, E. S. (2017). Online sexual activity experiences among college students:

A four-country comparison. *Archives of Sexual Behavior*, *46*, 1641–1652.

Douglas, K. S., Guy, L. S., & Hart, S. D. (2009). Psychosis as a risk factor for violence to others: A meta-analysis. *Psychological Bulletin*, *135*, 679–706.

Dovern, A., Fink, G. R., Fromme, A. C., Wohlschläger, A. M., Weiss, P. H., & Riedl, V. (2012). Intrinsic network connectivity reflects consistency of synesthetic experiences. *Journal of Neuroscience*, *32*, 7614–7621.

Dow Schull, N. (2012). *Addiction by design: Machine gambling in Las Vegas*. Princeton, NJ: Princeton University Press.

Dozois, D., Bieling, P., Patelis-Siotis, I., Hoar, L., Chudzik, S., McCabe, K., et al. (2009). Changes in self-schema structure in cognitive therapy for major depressive disorder: A randomized clinical trial. *Journal of Consulting and Clinical Psychology*, *77*, 1078–1088.

Drachman, D. A. (2005). Do we have a brain to spare? *Neurology*, *64*, 2004–2005.

Drachman, D. A., & Leavitt, J. (1974). Human memory and the cholinergic system. *Archives of Neurology*, *30*, 113–121.

Duan, Z., Andronescu, M., Schutz, K., McIlwain, S., Kim, Y. J., Lee, C., … Noble, W. S. (2010). A three-dimensional model of the yeast

genome. *Nature*, *465*, 363–367.

Dubessy, A.-L., Leu-Semenescu-S., Attali, V., Maranci, J.-B., & Arnulf, I. (2017). Sexomnia: A specialized non-REM parasomnia? *Sleep*, *40*, 1–9.

Duffy, J.F., & Czeisler, C. (2009). Effect of light on human circadian physiology. *Sleep Medicine Clinics*, *4*, 165–177.

Duka, T., Weissenborn, R., & Dienes, Z. (2001). State-dependant effects of alcohol on recollective experience, familiarity and awareness of memories. *Psychopharmacology*, *153*, 295–306.

Duke, J. C., Lee, Y. O., Kim, A. E., Watson, K. A., Arnold, K. Y., ... Porter, L. (2014). Exposure to electronic cigarette television advertisements among youth and young adults. *Pediatrics*, *134*, e29–e36.

Dunn, K. M., Cherkas, L. F., & Spector, T. D. (2005). Genetic influences on variation in female orgasmic function: A twin study. *Biology Letters*, *1*, 260–263.

Durante, K. M., Li, N. P., & Haselton, M. G. (2008). Changes in women's choice of dress across the ovulatory cycle: Naturalistic and laboratory task-based evidence. *Personality and Social Psychology Bulletin*, *34*, 1451–1460.

During, M. J., & Spencer, D. D. (1993). Extracellular hippocampal glutamate and spontaneous seizure in the conscious human brain.

Lancet, *341*, 1607–1610.

Durmer, J. S., & Dinges, D. F. (2005). Neurocognitive consequences of sleep deprivation. *Seminars in Neurology*, *25*, 117–129.

Durrant, J., & Ensom, R. (2012). Physical punishment of children: Lessons from 20 years of research. *Canadian Medical Association Journal*, *184*, 1373–1376.

Dutton, D. G., & Aron, A. (1974). Some evidence for heightened sexual attraction under conditions of high anxiety. *Journal of Personality and Social Psychology*, *30*, 510–517.

Dutton, E, van der Linden, D., & Lynn, R. (2016). The negative Flynn effect: A systematic literature review. *Intelligence*, *59*, 163–169.

Dutton, K. (2012). *The wisdom of psychopaths: What saints, spies, and serial killers can teach us about success*. Toronto: Doubleday Canada.

Dweck, C. (2002). Beliefs that make smart people dumb. In R. J. Sternberg (Ed.), *Why smart people can be so stupid* (pp. 24–41). New Haven, CT: Yale University Press.

Dykiert, D., Gale, C., & Deary, I. (2009). Are apparent sex differences in mean IQ scores created in part by sample restriction and increased male variance? *Intelligence*, *37*, 42–47.

Dzirasa, K., & Covington, H. E. III. (2012). Increasing the validity of experimental models for depression. *Annals of the New York Academy of Sciences*, *1265*, 36–45.

Eastwood, J., Snook, B., Luther, K., & Freedman, S. (2016). Engineering comprehensible youth interrogation rights. *New Criminal Law Review*, *19*, 42–62.

Eaton, W. E., Bienvenu, O. J., & Milo yan, B. (2018). Specific phobia. *The Lancet Psychiatry*, *5*, 678–686.

Ebbinghaus, H. (1885/1913). *Memory: A contribution to experimental psychology*. [Online]. Retrieved from http://psychclassics.yorku.ca/Ebbinghaus/

Eberhardt, J. L. (2005). Imaging race. *American Psychologist*, *60*, 181–190.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values, and goals. *Annual Review of Psychology*, *53*, 109–132.

Edwards, A. S. (1917). The distribution of time in learning small amounts of material. In *Studies in psychology: Titchener commemorative volume* (pp. 209–213). Worcester, MA: Wilson.

Edwards, J. G., Gibson, H. E., Jensen, T., Nugent, F., Walther, C., Blickenstaff, J., & Kauer, J. (2012). A novel non-CB1/TRPV1 endocannabinoid-mediated mechanism depresses excitatory

synapses on hippocampal CA1 interneurons. *Hippocampus*, *22*, 209–221.

Efrain, M. G., & Patterson, E. W. J. (1974). Voters vote beautiful: The effect of physical appearance on a national election. *Canadian Journal of Behavioural Science/Revue canadienne des sciences du comportement*, *6*, 352.

Eggum, N. D., Eisenberg, N., Spinrad, T. L., Valiente, C., Edwards, A., Kupfer, A. S., & Reiser, M. (2009). Predictors of withdrawal: Possible precursors of avoidant personality disorder. *Developmental Psychopathology*, *21*, 815–838.

Eich, E., & Metcalfe, J. (1989). Mood dependent memory for internal versus external events. *Journal of Experimental Psychology*, *15*, 443–455.

Eich, E., Macaulay, D., & Ryan, L. (1994). Mood dependent memory for events of the personal past. *Journal of Experimental Psychology*, *123*, 201–215.

Eich, E., Macaulay, D., Lowenstein, R. J., & Dihle, P. H. (1997). Memory, amnesia, and dissociative identity disorder. *Psychological Science*, *8*, 417–422.

Eichenbaum, H., Yonelinas, A. P., & Ranganath, C. (2007). The medial temporal lobe and recognition memory. *Annual Review of Neuroscience*, *30*, 123–152.

Eisenberg, N. (2000). Emotion, regulation, and moral development. *Annual Review of Psychology*, *51*, 665–697.

Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, *8*, 294–300.

Eisenegger, C., Haushofer, J., & Fehr, E. (2011). The role of testosterone in social interaction. *Trends in Cognitive Sciences*, *15*, 263–271.

Eiser, A. S. (2005). Physiology and psychology of dreams. *Seminars in Neurology*, *25*, 97–105.

Ekman, P., & Friesen, W. V. (1969). The repertoire of nonverbal behavior: Categories, origins, usage, and coding. *Semiotica*, *1*, 49–98.

Ekman, P., O'Sullivan, M., & Frank, M. G. (1999). A few can catch a liar. *Psychological Science*, *10*, 263–266.

Eldreth, D. A., Matochick, J. A., Cadet, J. L., & Bolla, K. I. (2004). Abnormal brain activity in prefrontal regions in abstinent marijuana users. *NeuroImage*, *23*, 914–920.

Elfenbein, H. A., & Ambady, N. (2003). Universals and cultural differences in recognizing emotions. *Current Directions in Psychological Science*, *12*, 159–164.

Elfenbein, H. A., Beaupré, M., Lévesque, M., & Hess, U. (2007). Toward a dialect theory: Cultural differences in the expression and recognition of posed facial expressions. *Emotion*, *7*, 131–146.

Elgar, F. J., Davis, C. G., Wohl, M. J., Trites, S. J., Zelenski, J. M., & Martin, M. S. (2011). Social capital, health and life satisfaction in 50 countries. *Health & Place*, *17*, 1044–1053.

Elkins, G., Marcus, J., Stearns, V., Perfect, M., Rajab, M. H., Ruud, C., et al. (2008). Randomized trial of a hypnosis intervention of hot flashes among breast cancer survivors. *Journal of Clinical Oncology*, *26*, 5022–5026.

Elkins, S. R., & Moore, T. M. (2011). A time-series study of the treatment of panic disorder. *Clinical Case Studies*, *10*, 3–22.

Elliot, A. J., & Niesta, D. (2008). Romantic red: Red enhances men's attraction to women. *Journal of Personality and Social Psychology*, *95*, 1150–1164.

Elliot, A. J., Tracy, J. L., Pazda, A. D., & Beall, A. T. (2013). Red enhances women's attractiveness to men: First evidence suggesting universality. *Journal of Experimental Social Psychology*, *49*, 165–168.

Elliott, R., Bohart, A., Watson, J., & Greenberg, L. (2011). Empathy. *Psychotherapy*, *48*, 43–49.

Elliott, R., Friston, K. J., & Dolan, R. J. (2000). Dissociable neural responses in human rewards systems. *Journal of Neuroscience*, *20*, 6159–6165.

Elliott, R., Newman, J. L., Longe, O. A., & Deakin, J. F. W. (2003). Differential response patterns in the striatum and orbitofrontal cortex to financial reward in humans: A parametric functional magnetic resonance imaging study. *Journal of Neuroscience*, *22*, 303–307.

Elliott, R., Sahakian, B. J., Matthews, K., Bannerjea, A., Rimmer, J., & Robbins, T. W. (1997). Effects of methylphenidate on spatial working memory and planning in healthy young adults. *Psychopharmacology*, *131*, 196–206.

Ellis, A. (1962). *Reason and emotion in psychotherapy*. New York: Lyle Stuart.

Ellis, B. J., & Garber, J. (2000). Psychosocial antecedents of variation in girls' pubertal timing: Maternal depression, stepfather presence, and marital and family stress. *Child Development*, *71*, 485–501.

Ellis, L., & Ames, M. (1987). Neurohormonal functioning and sexual orientation: A theory of homosexuality–heterosexuality. *Psychological Bulletin*, *101*, 233–258.

Environics Research Group. (2007). Testing of mock-ups of health warning messages and warning notices on tobacco product

advertisements for smokeless tobacco. Retrieved from www.tobaccolabels.ca/health/canada2007w2

Epel, E., Lapidus, R., McEwen, B., & Brownell, K. (2001). Stress may add bite to appetite in women: A laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology*, *26*, 37–49.

Epley, N., & Gilovich, T. (2006). The anchoring-and-adjustment heuristic: Why the adjustments are insufficient. *Psychological Science*, *17*, 311–318.

Epstein, S. (1994). Integration of the cognitive and the psychodynamic unconscious. *American Psychologist*, *49*, 709–724.

Erickson, K. I., Voss, M. W., Prakash, R. S., Basak, C., Szabo, A., Chaddock, L., et al. (2011). Exercise training increases size of hippocampus and improves memory. *Proceedings of the National Academy of Sciences, 108*, 3017–3022.

Ericsson, K. A., & Polson, P. G. (1988). Memory for restaurant orders. In M. Chi, R. Glaser, & M. Farr (Eds.), *The nature of expertise* (pp. 23–70). Hillsdale, NJ: Erlbaum.

Erikson, E. H. (1982). *The life cycle completed*. New York: Norton.

Eriksson, P. S., Perfilieva, E., Björk-Eriksson, T., Alborn, A. M., Nordborg, C., Peterson, D.A., & Gage, F. H. (1998). Neurogenesis in the adult human hippocampus. *Nature Medicine*, *4*, 1313–1317.

Evans, D., & Rothbart, M. K. (2007). Developing a model for adult temperament. *Journal of Research in Personality*, *41*, 868–888.

Evans, G. W., & Schamberg, M. A. (2009). Childhood poverty, chronic stress, and adult working memory. *Proceedings of the National Academy Sciences*, *106*(16), 6545–6549.

Evans, G. W., & Stecker, R. (2004). Motivational consequences of environmental stress. *Journal of Environmental Psychology*, *24*, 143–165.

Evans, G.W. (2003). The built environment and mental health. *Journal of Urban Health*, *80*, 536–555.

Evans, S., Ferrando, S., Findler, M., Stowell, C., Smart, C., & Haglin, D. (2008). Mindfulness-based cognitive therapy for anxiety. *Journal of Anxiety Disorders*, *22*, 716–721.

Exner, J. E. (1991). *The Rorschach: A comprehensive system. Vol. 2: Interpretation* (2nd ed.). New York: Wiley.

Eysenck, H. J. (1967). *The biological basis of personality*. Springfield, IL: Charles C. Thomas.

Eysenck, H. J. (1994). Personality: Biological foundations. In P. A. Vernon (Ed.), *The neuropsychology of individual differences*. London: Academic Press.

Fairclough, S. H., & Graham, R. (1999). Impairment of driving performance caused by sleep deprivation or alcohol: A comparative study. *Human Factors*, *41*, 118–128.

Fakhoury, W., & Priebe, S. (2002). The process of de-institutionalisation: An international overview. *Current Opinion in Psychiatry*, *15*, 187–192.

Falbe, J., Thompson, H. R., Becker, C. M., Rojas, N. McCulloch, C. E., & Madsen, K. A. (2016). Impact of the Berkeley Excise Tax on sugar-sweetened beverage consumption. *American Journal of Public Health*, *106*, 1865–1871.

Fan, J., Gan, J., Liu, W., Zhong, M., Liao, H., ...& Zhu, X. (2018). Resting-state default mode network related functional connectivity is associated with sustained attention deficits in schizophrenia and obsessive-compulsive disorder. *Frontiers in Behavioral Neuroscience*, *12*, 319.

Fancher, R. E. (1985). *The intelligence men: Makers of the IQ controversy*. New York: W. W. Norton.

Fancher, R. E. (1990). *Pioneers of psychology*. New York: W. W. Norton & Company.

Fancher, R. E. (2009). Scientific cousins: The relationship between Charles Darwin and Francis Galton. *American Psychologist*, *64*, 84–92.

Fanselow, M. S., & Gale, G. D. (2003). The amygdala, fear, and memory. *Annals of the New York Academy of Sciences*, *985*, 125–134

Fantz, R. L. (1961). The origin of form perception. *Scientific American*, *47*, 627–638.

Farb, N. A. S., Segal, Z. V., Mayberg, H., Bean, J., McKeon, D., ... Anderson, A. K. (2007). Attending to the present: Mindfulness meditation reveals distinct neural modes of self-reference. *Social Cognitive and Affective Neuroscience*, *2*, 313–322.

Farb, N. A., Segal, Z. V., & Anderson, A. K. (2013). Mindfulness meditation training alters cortical representations of interoceptive attention. *Social, Cognitive & Affective Neuroscience*, *8*, 15–26.

Farber, B. A., & Lane, J. S. (2002). Positive regard. In J. C. Norcross (Ed.), *Psychotherapy relationships that work* (pp. 175–194). New York: Oxford University Press.

Fay, R. R. (1988). *Hearing in vertebrates: A psychophysics databook*. Winnetka, IL: Hill-Fay Associates.

Fazel, S., Långström, N., Hjern, A., Grann, M., & Lichtenstein, P. (2009). Schizophrenia, substance abuse, and violent crime. *Journal of the American Medical Association*, *301*, 2016–2023.

Fecteau, S., Knoch, D., Fregni, F., Sultani, N., Boggio, P., & Pascual-Leone, A. (2007). Diminishing risk-taking behavior by modulating

activity in the prefrontal cortex: A direct current stimulation study. *Journal of Neuroscience*, *27*, 12500–12505.

Fecteau, S., Pascual-Leone, A., Zald, D. H., Liguori, P., Theoret, H., Boggio, P. S., & Fregni, F. (2007). Activation of prefrontal cortex by transcranial direct current stimulation reduces appetite for risk during ambiguous decision making. *Journal of Neuroscience*, *27*, 6212–6218.

Feduccia, A. A., & Mithoefer, M. C. (2018). MDMA-assisted psychotherapy for PTSD : Are memory reconsolidation and fear extinction underlying mechanisms ? *Progress in Neuropsychopharmacology & Biological Psychiatry*, *84*, 221–228.

Fehr, B. (1988). Prototype analysis of the concepts of love and commitment. *Journal of Personality and Social Psychology*, *55*, 557–579.

Fehr, B. (2003). The status of theory and research on love and commitment. In G. J. O. Fletcher and M. S. Clark (Eds.), *Blackwell handbook of social psychology: Interpersonal processes* (pp. 331–356). Malden, MA: Blackwell Publishers Ltd.

Fein, S., & Spencer, S. J. (1997). Prejudice as self-image maintenance: Affirming the self through derogating others. *Journal of Personality and Social Psychology*, *73*, 31–44.

Feinberg, D. R., DeBruine, L. M., Jones, B. C., & Perret, D. I. (2008). The role of femininity and averageness of voice pitch in aesthetic

judgements of women's voices. *Perception*, *37*, 615–623.

Feinberg, D. R., Jones, B. C., DeBruine, L. M., Moore, F. R., Smith, M. J. L., Cornwell, E. R., et al. (2005). The voice and face of woman: One ornament that signals quality? *Evolution and Human Behavior*, *26*, 298–408.

Feinberg, I., Jones, R. Walker, J., Cavness, C., & Floyd, T. (1976). Effects of marijuana extract and tetrahydrocannabinol on electroencephalographic sleep patterns. *Clinical Pharmacology and Therapeutics*, *18*, 782–794.

Ferguson, C. J. (2015). Do angry birds make for angry children? A meta-analysis of video game influences on children's and adolescents' aggression, mental health, prosocial behavior, and academic performance. *Perspectives on Psychological Science*, *10*, 646–66.

Ferguson, C.J. (2017). Everything in moderation: Moderate use of screens unassociated with child behavior problems. *Psychiatric Quarterly*, *88*, 797-805.

Fernandes, J. (2013). Effects of negative political advertising and message repetition on candidate evaluation. *Mass Communication and Society*, *16*, 268–291.

Fernández, A., & Alonso, M. A. (2001). The relative value of environmental context reinstatement in free recall. *Psicologica*, *22*, 253–266.

Ferrer, E., & McArdle, J. J. (2004). An experimental analysis of dynamic hypotheses about cognitive abilities and achievement from childhood to early adulthood. *Developmental Psychology*, *40*, 935–952.

Ferster, C. B., & Skinner, B. F. (1957). *Schedules of reinforcement*. Englewood Cliffs, NJ: Prentice Hall.

Festinger, L. (1957). *A theory of cognitive dissonance*. Redwood City, CA: Stanford University Press.

Festinger, L., & Carlsmith, J. M. (1959). Cognitive consequences of forced compliance. *Journal of Abnormal and Social Psychology*, *58*, 203–210.

Festinger, L., Reicken, H., & Schachter, S. (1956). *When prophecy fails: A social and psychological study of a modern group that predicted the destruction of the world*. New York: Harper-Torchbooks.

Field, A. E., Austin, S. B., Taylor, C. B., Malspeis, S., Rosner, B., Rockett, H. R., et al. (2003). Relation between dieting and weight change among preadolescents and adolescents. *Pediatrics*, *112*, 900–906.

Field, T., Diego, M. A., Hernandez-Reif, M., Deeds, O., & Figuereido, B. (2006). Moderate versus light pressure massage therapy leads to greater weight gain in preterm infants. *Infant Behavior and Development*, *29*, 574–578.

Filler, A. (2009). Magnetic resonance neurography and diffusion tensor imaging: Origins, history, and clinical impact of the first 50,000 cases with an assessment of efficacy and utility in a prospective 5000-patient study group. *Neurosurgery*, *65*, A29–43.

Finger, E. C., Marsh, A. A., Mitchell, D. G., Reid, M. E., Sims, C., Budhani, S., et al. (2008). Abnormal ventromedial prefrontal cortex function in children with psychopathic traits during reversal learning. *Archives of General Psychiatry*, *65*, 586–594.

Fiorino, D. F., Coury, A., & Phillips, A. G. (1997). Dynamic changes in nucleus accumbens dopamine efflux during the Coolidge effect in male rats. *Journal of Neuroscience*, *17*, 4849–4855.

Fiscella, K., Tancredi, D., & Franks, P. (2009). Adding socioeconomic status to Framingham scoring to reduce disparities in coronary risk assessment. *American Heart Journal*, *157*, 988–994.

Fischer, P., & Greitemeyer, T. (2006). Music and aggression: The impact of sexual-aggressive song lyrics on aggression-related thoughts, emotions, and behaviour toward the same and the opposite sex. *Personality and Social Psychology Bulletin*, *32*, 1165–1176.

Fischer, P., Kastenmüller, A., & Greitmeyer, T. (2010). Media violence and the self: The impact of personalized gaming characters in aggressive video games on aggressive behavior. *Journal of Experimental Social Psychology*, *46*, 192–195.

Fitzgerald, K. D., Welsh, R. C., Gehring, W. J., Abelson, J. L., Himle, J. A., ... Taylor, S. F. (2005). Error-related hyperactivity of the anterior cingulate cortex in obsessive–compulsive disorder. *Biological Psychiatry*, *57*, 287–294.

Fitzpatrick, E. M., Johnson, E., & Durieux-Smith, A. (2011). Exploring factors that affect age of cochlear implantation in children. *International Journal of Pediatric Otolaryngology*, *75*, 1082–1087.

Fivush, R., & Nelson, K. (2004). Culture and language in the emergence of autobiographical memory. *Psychological Science*, *15*, 573–577.

Fletcher, J. (2012). Positive parenting, not physical punishment. *Canadian Medical Association Journal*, *184*(12), 1339.

Flett, G. L., Krames, L., & Vredenburg, K. (2009). Personality traits in clinical and remitted depression: An analysis of instrumental-agentic and expressive-communal traits. *Current Psychology*, *28*, 240–248.

Floel, A., Poeppel, D., Buffalo, E. A., Braun, A., Wu, C. W., ... Cohen, L. G. (2004). Prefrontal cortex asymmetry for memory encoding of words and abstract shapes. *Cerebral Cortex*, *14*, 404–409.

Flora, C. (2005, July). The grandmaster experiment. *Psychology Today*. Retrieved from www.psychologytoday.com/articles/200506/the-grandmaster-experiment

Flourens, M. J. P. (1824). *Recherches expérimentales sur les propriétés et les fonctions du système nerveux dans les animaux vertébrés*. Paris: Crevot.

Flynn, D. J., Nyhan, B., & Reifler, J. (2017). The nature and origins of misperceptions: Understanding false and unsupported beliefs about politics. *Political Psychology 38*(S1), 127–50.

Flynn, J. R. (1987). Massive IQ gains in 14 nations: What IQ tests really measure. *Psychological Bulletin*, *101*, 171–191.

Flynn, J. R. (2007). *What is intelligence? Beyond the Flynn effect*. New York: Cambridge University Press.

Flynn, J. R., & Rossi-Casé, L. (2011). Modern women match men on Raven's Progressive Matrices. *Personality and Individual Differences*, *50*, 799–803.

Foa, E. B., Huppert, J. D., *&* Cahill, S. P. (2006). Emotional processing theory: An update. In B. O. Rothbaum and B. O. Rothbaum (Eds.), *Pathological anxiety: Emotional processing in etiology and treatment* (pp. 3–24). New York: *Guilford Press*.

Foer, J., & Siffre, M. (2008). Caveman: An interview with Michel Siffre. *Cabinet*, *30*. Retrieved from www.cabinetmagazine.org/issues/30/foer.php

Folkman, S., & Lazarus, R. S. (1980). An analysis of coping in a middle-aged community sample. *Journal of Health and Social Behavior*, *21*,

219–239.

Fonagy, P., & Target, M. (1997). Attachment and reflective function: Their role in self-organization. *Development and Psychopathology*, *9*, 679–700.

Fonagy, P., Steele, M., Steele, H., Leigh, T., Kennedy, R., ... Target, M. (1995). Attachment, the reflective self, and borderline states: The predictive specificity of the Adult Attachment Interview and pathological emotional development. In *Attachment theory: Social, developmental, and clinical perspectives* (pp. 233–278). Hillsdale, NJ: Analytic Press.

Fong, G. T., Hammond, D., & Hitchman, S. C. (2009). The impact of pictures on the effectiveness of tobacco warnings. *Bulletin of the World Health Organization*, *87*, 640–643.

Fontanilla, D., Johannessen, M., Hajipour, A. R., Cozzi, N. V., Meyer, B. J., & Ruoho, A. E. (2009). The hallucinogen N, N-dimethyltryptamine (DMT) is an endogenous sigma-1 receptor regulator. *Science*, *323*, 934–937.

Ford, D. (2002). *The dark side of the light chasers*. New York: Riverhead Books.

Forer, B. R. (1949). The fallacy of personal validation: A classroom demonstration of gullibility. *Journal of Abnormal and Social Psychology*, *44*, 118–123.

Forgas, J. P. (Ed.). (2000). *Handbook of affect and social cognition*. Mahwah, NJ: Lawrence Erlbaum Associates Publishers.

Forlini, C., Gauthier, S., & Racine, E. (2013). Should physicians prescribe cognitive enhancers to healthy individuals? *Canadian Medical Association Journal*, *185*, 1047–1050.

Foroud, T., Edenberg, H. J., & Crabbe, J. C. (2010). Genetic research: Who is at risk for alcoholism? *Alcohol Research & Health*, *33*, 64–75.

Foroughi, C. K., Monfort, S. S., Paczynski, M., McKnight, P. E., & Greenwood, P. M. (2016). Placebo effects in cognitive training. *Proceedings of the National Academy of Sciences of the United States of America*, *113*, 7470–7474.

Foster, D. W., Neighbors, C., & Krieger, H. (2015). Alcohol evaluations and acceptability: Examining descriptive and injunctive norms among heavy drinkers. *Addictive Behaviors*, *42*, 101–107.

Foster, E. M., & Watkins, S. (2010). The value of reanalysis: Television viewing and attention problems. *Child Development*, *81*, 368–375.

Foucault, M. (1975). *Discipline and punish: The birth of the prison*. New York: Random House.

Fournier, A. K., Ehrhart, I. J., Glindemann, K. E., & Geller, E. (2004). Intervening to decrease alcohol abuse at university parties:

Differential reinforcement of intoxication level. *Behavior Modification*, *28*, 167–181.

Fouts, R. S. (1997). *Next of kin: What chimpanzees tell us about who we are*. New York: Avon Books.

Fowler, G., Cope, C., Michalski, D., Christidis, P., Lin, L., & Conroy, J. (2018). Women outnumber men in psychology graduate programs. *American Psychological Association*, *49*(11).

Fox, E., Ridgewell, A., & Ashwin, C. (2009). Looking on the bright side: Biased attention and the human serotonin transporter gene. *Proceedings of the Royal Society, B.*, *276*, 1747–1751.

Fox, J., Blank, M., Rovnyak, V., & Barnett, R. (2001). Barriers to help seeking for mental disorders in a rural impoverished population. *Community Mental Health Journal*, *37*, 421–436.

Fox, K. C. R., Spreng, R. N., Ellamil, M., Andews-Hanna, J. R., & Christoff, K. (2015). The wandering brain: Meta-analysis of functional neuroimaging studies of mind-wandering and related spontaneous thought processes. *NeuroImage*, *111*, 611–621.

Fox, S. (2005). Health information online. *Pew Internet and American Life Project*. Retrieved from www.pewinternet.org

Francis, D., Diorio, J., Liu, D., & Meaney, M. J. (1999). Nongenomic transmission across generations of maternal behavior and stress

responses in the rat. *Science*, *286*, 1155–1158.

Frank, L. (2018). *The pleasure shock: The rise of deep brain stimulation and its forgotten inventor*. New York: Dutton.

Frankel, F. H. (1993). Adult reconstruction of childhood events in the multiple personality literature. *American Journal of Psychiatry*, *150*, 954–958.

Frankl, V. (1959). *Man's search for meaning*. New York: Washington Square Press.

Franks, N., & Richardson, T. (2006). Teaching in tandem-running ants. *Nature*, *439*, 153.

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology. *American Psychologist*, *56*, 218–226.

Fredrickson, B. L. (2003). The value of positive emotions. *American Scientist*, *91*, 330–335.

Fredrickson, B. L., & Branigan, C. (2005). Positive emotions broaden the scope of attention and thought-action repertoires. *Cognition and Emotion*, *19*, 313–332.

Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition and Emotion*, *12*, 191–220.

Freedman, G., Powell, D. N., Le, B., & Williams, K. D. (2018). Ghosting and destiny: Implicit theories of relationships predict beliefs about ghosting. *Journal of Social and Personal Relationships*, *36*, 905–924.

French, L., & Pavlidis, P. (2011). Using text mining to link journal articles to neuroanatomical databases. *Journal of Comparative Neurology*, *520*, 1772–1783.

Freud, A. (1936). *The ego and the mechanisms of defense*. London: Hogarth Press & Institute of Psycho-Analysis.

Freud, A. (1958). Adolescence. *Psychoanalytic Study of the Child*, *13*, 255–278.

Freud, S. (1899/2011). *The interpretation of dreams*. New York: Avon.

Freud, S. (1905/2000). *Three essays on the theory of sexuality*. New York: Basic Books Classics.

Freud, S. (1920). *A general introduction to psychoanalysis*. New York: Liveright Publishing.

Frewen, P. A., Dozois, D. J., & Lanius, R. A. (2008). Neuroimaging studies of psychological interventions for mood and anxiety disorders: Empirical and methodological review. *Clinical Psychology Review*, *28*, 228–246.

Frias, A., Watkins, P. C., Webber, A. C., & Froh, J. J. (2011). Death and gratitude: Death reflection enhances gratitude. *Journal of Positive Psychology*, *6*, 154–162.

Fridlund, A. J., Beck, H. P., Goldie, W. D., & Irons, G. (2012). Little Albert: A neurologically impaired child. *History of Psychology*, *15*, 302–327.

Fried, P., Watkinson, B., James, D., & Gray, R. (2002). Current and former marijuana use: Preliminary findings of a longitudinal study of the effects on IQ in young adults. *Canadian Medical Association Journal*, *166*, 887–891.

Friederich, H. C., Brooks, S., Uher, R., Campbell, I. C., Giampietro, V., Brammer, M., et al. (2010). Neural correlates of body dissatisfaction in anorexia nervosa. *Neuropsychologia*, *48*, 2878–2885.

Friedman, M., & Rosenman, R. (1959). Association of specific overt behaviour pattern with blood and cardiovascular findings. *Journal of the American Medical Association*, *169*, 1286–1296.

Friedman, M., & Rosenman, R. H. (1974). *Type A behavior and your heart*. New York: Knopf.

Frijters, J. C., Lovett, M. W., Sevcik, R. A., & Morris, R. D. (2013). Four methods of identifying change in the context of a multiple component reading intervention for struggling middle school readers. *Reading and Writing*, *26*, 539–563.

Frisch, R. E., & Barbieri, R. L. (2002). *Female fertility and body fat connection*. Chicago: University of Chicago Press.

Frodi, A., Bridges, L., & Grolnick, W. (1985). Correlates of mastery-related behavior: A short-term longitudinal study of infants in their second year. *Child Development*, *56*, 1291–1298.

Fu, C. H., Abel, K. M., Allin, M. P., Gasston, D., Costafreda, S. G., Suckling, J., et al. (2005). Effects of ketamine on prefrontal and striatal regions in an overt verbal fluency task: A functional magnetic resonance imaging study. *Psychopharmacology*, *183*, 92–102.

Fujioka, T., Mourad, N., & Trainor, L. J. (2011). Development of auditory-specific brain rhythm in infants. *European Journal of Neuroscience*, *33*, 521–529.

Fukushima, H., Terasawa, Y., & Umeda, S. (2011). Association between interoception and empathy: Evidence from heartbeat-evoked brain potential. *International Journal of Psychophysiology*, *79*, 259–265.

Fulda, S., & Schulz, H. (2003). Cognitive dysfunction in sleep-related breathing disorders: A meta-analysis. *Sleep Research Online*, *5*, 13–43.

Fuller, R., Nopoulos, P., Arndt, S., O'Leary, D., Ho, B. C., & Andreasen, N. C. (2002). Longitudinal assessment of premorbid cognitive functioning in patients with schizophrenia through examination of

standardized scholastic test performance. *American Journal of Psychiatry*, *159*, 1183–1189.

Furer, T., Nayak, K., & Shatkin, J. P. (2018). Exploring interventions for sleep disorders in adolescent cannabis users. *Medical Sciences*, *6*, 11.

Furley, P., Memmert, D., & Heller, C. (2010). The dark side of visual awareness in sport—inattentional blindness in a real-world basketball task. *Attention, Perception, & Psychophysics*, *72*, 1327–1337.

Gaertner, S. L., & Dovidio, J. F. (2000). *Reducing intergroup bias: The common ingroup identity model*. New York: Psychology Press.

Gais, S., Molle, M., Helms, K., & Born, J. (2002). Learning-dependent increases in sleep spindle density. *Journal of Neuroscience*, *22*, 6830–6834.

Galaburda, A. M., & Pandya, D. N. (1982). Role of architectonics and connections in the study of primate brain evolution. In E. Armstrong, et al. (Eds.), *Primate brain evolution* (pp. 203–216). New York: Plenum Press.

Galambos, N. L., Vargas Lascano, D. I., Howard, A. L., & Maggs, J. L. (2013). Who sleeps best? Longitudinal patterns and covariates of change in sleep quantity, quality, and timing across four university years. *Behavioral Sleep Medicine*, *11*, 8–22.

Gallagher, R. P. (2007). *National Survey of Counseling Center Directors (2007)*. Washington, DC: International Association of Counseling Services. Retrieved from http://www.iacsinc.org/

Gallo, D., Roberts, M., & Seamon, J. (1997). Remembering words not presented in lists: Can we avoid creating false memories? *Psychonomic Bulletin & Review*, *4*, 271–276.

Galobardes, B., Smith, G. D., & Lynch, J. W. (2006). Systematic review of the influence of childhood socioeconomic circumstances on risk for cardiovascular disease in adulthood. *Annals of Epidemiology*, *16*, 91–104.

Galton, F. (1869). *Hereditary genius*. London: Macmillan.

Galvan, A., Hare, T. A., Parra, C. E., Penn, J., Voss, H., ... Casey, B. J. (2006). Earlier development of the accumbens relative to orbitofrontal cortex might underlie risk-taking behavior in adolescents. *The Journal of Neuroscience*, *26*, 6885–6892.

Gangestad, S. W., Thornhill, R., & Yeo, R. A. (1994). Facial attractiveness, developmental stability, and fluctuating asymmetry. *Ethology and Sociobiology*, *15*, 73–85.

Gao, X., Pan, W., Li, C., Weng, L., Yao, M., & Chen, A. (2017). Long-time exposure to violent video games does not show desensitization on empathy for pain: an fMRI study. *Frontiers in Psychology*, *8*, article 650.

Garb, H. N., Wood, J. M., Lilienfeld, S. O., & Nezworski, M. T. (2005). Roots of the Rorschach controversy. *Clinical Psychology Review*, *25*, 97–118.

Garbutt, J. (2009). The state of pharmacotherapy for the treatment of alcohol dependence. *Journal of Substance Abuse Treatment*, *36*, S15–S23.

Garcia-Falgueras, A., & Swaab, D. F. (2008). A sex difference in the hypothalamic uncinate nucleus: relationship to gender identity. *Brain*, *131*, 3132–3146.

Garcia, J., Ervin, F. R., & Koelling, R. A. (1966). Learning with prolonged delay of reinforcement. *Psychonomic Science*, *5*, 121–122.

Gardner, D. (2008). *Risk*. Toronto: McClelland & Stewart.

Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. New York: Basic Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century*. New York: Basic Books.

Gardner, R. A., Gardner, B. T., & VanCantfort, T. E. (1989). *Teaching sign language to chimpanzees*. Albany, NY: State University of New York Press.

Garland, S. N., Rowe, H., Repa, L. M., Fowler, K., Zhou, E. S., & Grandner, M. A. (2018). A decade's difference: 10-year change in insomnia symptom prevalence in Canada depends on sociodemographics and health status. *Sleep Health*, *4*, 160–165.

Garrow, J. S., & Stalley, S. (1975). Is there a "set point" for human body weight? *Proceedings of the Nutrition Society*, *34*, 84–85.

Garry, M., & Polaschek, D. (2000). Imagination and memory. *Current Directions in Psychological Science*, *9*, 6–10.

Garry, M., Manning, C., Loftus, E., & Sherman, S. (1996). Imagination inflation: Imagining a childhood event inflates confidence that it occurred. *Psychonomic Bulletin & Review*, *3*, 208–214.

Gaser, C., & Schlaug, G. (2003). Brain structures differ between musicians and non-musicians. *Journal of Neuroscience*, *23*, 9240–9245.

Gasser, P., Kirchner, K., & Passie, T. (2015). LSD-assisted psychotherapy for anxiety associated with life-threatening diseases: A qualitative study of acute and sustained subjective effects. *Journal of Pharmacology*, *29*, 57–68.

Gaudet, S., Clement, R., & Deuzeman, K. (2005). Daily hassles, ethnic identity and psychological adjustment among Lebanese-Canadians. *International Journal of Psychology*, *40*, 157–168.

Gauthier, I. (2018). Domain-specific and domain-general individual differences in visual object recognition. *Current Directions in Psychological Science*, *27*, 97–102.

Gauthier, I., & Tarr, M. J. (1997). Becoming a "Greeble" expert: Exploring mechanisms for face recognition. *Vision Research*, *37*, 1673–1682.

Gauthier, I., Skudlarski, P., Gore, J. C., & Anderson, A. W. (2000). Expertise for cars and birds recruits brain areas involved in face recognition. *Nature Neuroscience*, *3*, 191–197.

Gauthier, I., Tarr, M. J., Anderson, A. W., Skudlarski, P., & Gore, J. C. (1999). Activation of the middle fusiform "face area" increases with expertise in recognizing novel objects. *Nature Neuroscience*, *2*, 568–573.

Gawryluk, J. R., D'arcy, R. C. N., Connolly, J. F., & Weaver, D. F. (2010). Improving the clinical assessment of consciousness with advances in electrophysiological and neuroimaging techniques. *Neurology*, *10*, 1–7.

Gazzaniga, M. S. (1967). The split-brain in man. *Scientific American*, *217*, 24–29.

Gazzaniga, M. S. (2000). Cerebral specialization and interhemispheric communication. *Brain*, *123*, 1293–1326.

Geake, J. G., & Hansen, P. C. (2010). Functional neural correlates of fluid and crystallized intelligence. *NeuroImage*, *49*, 3489–3497.

Gegenfurtner, K. R., Bloj, M., & Toscani, M. (2015). The many colours of "the dress." *Current Biology*, *25*, R543–R544.

Geier, A., Rozin, P., & Doros, G. (2006). Unit bias: A new heuristic that helps explain the effect of portion size on food intake. *Psychological Science*, *17*, 521–525.

Geller, J., Cockell, S. J., Hewitt, P. L., Goldner, E. M., & Flett, G. L. (2000). Inhibited expression of negative emotions and interpersonal orientation in anorexia nervosa. *International Journal of Eating Disorders*, *28*, 8–19.

Gelman, M., Kosma, L., Wurm, C. S., & Keks, N. (2000). Viktor Emil Frankl 1905–1997. *American Journal of Psychiatry*, *157*, 625.

George, M. S., Raman, R., Benedek, D. M., Pelic, C. G., Grammer, G. G., ... Stein, M. B. (2014). A two-site pilot randomized 3 day trial of high dose left prefrontal repetitive transcranial magnetic stimulation (rTMS) for suicidal inpatients. *Brain Stimulation*, *7*, 421–431.

Gershoff, E. T. (2002). Parental corporal punishment and associated child behaviors and experiences: A meta-analytic and theoretical review. *Psychological Bulletin*, *128*, 539–579.

Gershoff, E. T., & Bitensky, S. H. (2007). The case against corporal punishment of children: Converging evidence from social science research and international human rights law and implications for U.S. public policy. *Psychology, Public Policy, and the Law*, *13*, 231–272.

Geschwind, N., Peeters, F., Drukker, M., van Os, J., & Wichers, M. (2011). Mindfulness training increases momentary positive emotions and reward experience in adults vulnerable to depression: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *79*, 618–628.

Geuter, S., Koban, L., & Wager, T.D. (2017). The cognitive neuroscience of placebo effects: Concepts, predictions, and physiology. *Annual Review of Neuroscience*, *40*, 167–188. https://doi.org/10.1146/annurev-neuro-072116-031132

Ghassemzadeh, H., Rothbart, M. K., & Posner, M. I. (2019). Anxiety and brain networks of attentional control. *Cognitive and Behavioral Neurology*, *32*, 54–62.

Gibbons, M., Crits-Christoph, P., & Hearon, B. (2008). The empirical status of psychodynamic therapies. *Annual Review of Clinical Psychology*, *4*, 93–108.

Gibson, E. J., & Walk, R. D. (1960). The "visual cliff." *Scientific American*, *202*, 67–71.

Gibson, V. (2019, February 14). As more students seek mental-health care, they face long waits – or pay out of pocket – as universities struggle with demand. *The Globe & Mail*. Retrieved from www.theglobeandmail.com

Giedd, J. N. (2008). The teen brain: Insights from neuroimaging. *Journal of Adolescent Health*, *42*, 335–343.

Gigerenzer, G. (2004). Dread risk, September 11, and fatal traffic accidents. *Psychological Science*, *15*, 286–287.

Gilbert, D. T., King, G., Pettigrew, S., & Wilson, T. D. (2016). Comment on "Estimating the reproducibility of psychological science." *Science*, *351*, 1037a–1037b.

Gillham, N. W. (2001). *A life of Sir Francis Galton: From African exploration to the birth of eugenics*. New York: Oxford University Press.

Gilligan, C. (1982). *In a different voice: Psychological theory and women's development*. Cambridge, MA: Harvard University Press.

Gilovich, T., & Griffin, D. (2002). Introduction: Heuristics and biases: Then and now. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 1–18). New York: Cambridge University Press.

Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive*

Psychology, *17*, 295–314.

Ginosar, S., Rakelly, K., Sachs, S., Yin, B., & Efros, A. A. (2015). *A century of portraits: A visual historical record of American high school yearbooks*. Extreme Imaging Workshop, International Conference on Computer Vision, ICCV.

Glass, W. G., McDermott, D. H., Lim, J. K., Lekhong, S., Yu, S. F., Frank, W. A., ... Murphy, P. M. (2006). CCR5 deficiency increases risk of symptomatic West Nile virus infection. *The Journal of Experimental Medicine*, *203*, 35–40.

Glenberg, A., Smith, S., & Green, C. (1977). Type I rehearsal: Maintenance and more. *Journal of Verbal Learning & Verbal Behavior*, *16*, 339–352.

Glenn, A. L., Johnson, A. K., & Raine, A. (2013). Antisocial personality disorder : A current review. *Current Psychiatry Reports*, *15*, 427.

Glenn, N. D. (1990). Quantitative research on marital quality in the 1980s: A critical review. *Journal of Marriage and the Family*, *52*, 818–831.

Glick, P., & Fiske, S. T. (1996). The ambivalent sexism inventory: Differentiating hostile and benevolent sexism. *Journal of Personality and Social Psychology*, *70*, 491–512.

Glick, P., & Fiske, S. T. (2001). An ambivalent alliance: Hostile and benevolent sexism as complementary justifications for gender inequality. *American Psychologist*, *56*, 109–118.

Glindemann, K. E., Ehrhart, I. J., Drake, E. A., & Geller, E. S. (2007). Reducing excessive alcohol consumption at university fraternity parties: A cost-effective incentive/reward intervention. *Addictive Behaviors*, *32*, 39–48.

Gluckman, M., Vlach, H. A., & Sandhofer, C. M. (2014). Spacing simultaneously promotes multiple forms of learning in children's science curriculum. *Applied Cognitive Psychology*, *28*, 266–273.

Gobet, F., & Simon, H. A. (1998). Expert chess memory: Revisiting the chunking hypothesis. *Memory*, *6*, 225–255.

Godden, D. R., & Baddeley, A. D. (1975). Context-dependent memory in two environments: On land and underwater. *British Journal of Psychology*, *66*, 325–331.

Goff, L. M., & Roediger III, H. L. (1998). Imagination inflation for action events: Repeated imaginings lead to illusory recollections. *Memory & Cognition*, *26*, 20–33.

Gogtay, N., Giedd, J. N., Lusk, L., Hayashi, K. M., Greenstein, D., Vaituzis, C., et al. (2004). Dynamic mapping of human cortical development during childhood through early adulthood. *Proceedings of the National Academy of Sciences*, *101*, 8174–8179.

Goh, J. O., Chee, M. W., Tan, J. C., Venkatraman, V., Hebrank, A., Leshikar, E. D., et al. (2007). Age and culture modulate object processing and object-scene binding in the ventral visual area. *Cognitive, Affective, & Behavioral Neuroscience*, *7*, 44–52.

Goland, R. S., Wardlaw, S. L., MacCarter, G., Warren, W. B., & Stark, R. I. (1991). Adrenocorticotropin and cortisol responses to vasopressin during pregnancy. *Journal of Clinical Endocrinology and Metabolism*, *73*, 257–261.

Golden, W. L. (2007). Cognitive-behavioral hypnotherapy in the treatment of irritable-bowel–syndrome-induced agoraphobia. *International Journal of Clinical and Experimental Hypnosis*, *55*, 131–146.

Goldman-Rakic, P. S. (1996). The prefrontal landscape: Implications of functional architecture for understanding human mentation and the central executive. *Philosophical Transactions of the Royal Society of London (B Biological Sciences*), *351*(1346), 1445–1453.

Goldsen, J., Bryan, A. E. B., Kim, H-J., Muraco, A., Jen, S., & Fredriksen-Goldsen, K. I., (2017). Who Says I Do: The changing context of marriage and health and quality of life for LGBT older adults, *The Gerontologist*, *57*, S50–S62.

Goldstein, A. L., Flett, G. L., Wekerle, C., & Wall, A-M. (2009). Personality, child maltreatment, and substance use: Examining correlates of deliberate self-harm among university students. *Canadian Journal of Behavioural Sciences*, *41*, 241–251.

Goldstein, A., & Flett, G. L. (2009). Personality, alcohol use, and drinking motives: A comparison of independent and combined internal drinking motives groups. *Behavior Modification*, *33*, 182–198.

Goletzke, J., Kocalevent, R. D., Hansen, G., Rose, M., Becher, H., Hecher, K., … Diemert, A. (2017). Prenatal stress perception and coping strategies: Insights from a longitudinal prospective pregnancy cohort. *Journal of Psychosomatic Research*, *102*, 8–14.

Golimbet, V. E., Alfimova, M. V., Sherbatikh, T. V., & Rogaev, E. I. (2003). Serotonin transporter gene polymorphism and personality traits measured by MMPI. *Russian Journal of Genetics*, *39*, 435–439.

Gollan, T. H., & Acenas, L. R. (2004). What is a TOT? Cognate and translation effects on tip-of-the-tongue states in Spanish-English and Tagalog-English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *30*, 246–269.

Gomez, R., Cooper, A., & Gomez, A. (2000). Susceptibility to positive and negative mood states: Test of Eysenck's, Gray's, and Newman's theories. *Personality and Individual Differences*, *29*, 351–365.

Gong, D., Ma, W., Gong, J., He, H., Dong, L., Zhang, D., … Yao, D. (2017). Action video game experience related to altered large-scale white matter networks. *Neural Plasticity*, *2017*, 1–7.

Goodale, M. A., Milner, A. D., Jakobson, L. S., & Carey, D. P. (1991). A neurological dissociation between perceiving objects and grasping

them. *Nature*, *349*, 154–156.

Goodall, J., & Berman, P. (1999). *A reason for hope: A spiritual journey*. New York: Warner Books.

Goode, C., Balzarini, R. H., & Smith, H. J. (2014). Positive peer pressure: Priming member prototypicality can decrease undergraduate drinking. *Journal of Applied Social Psychology*, *44*, 567–578.

Goodman, M. B. & Moradi, B. (2008). Attitudes and behaviors toward lesbian and gay persons: Critical correlates and mediated relations. *Journal of Counseling Psychology*, *55*, 371–384.

Goodwin, D. W., Powell, B., Bremer, D., Hoine, H., & Stern, J. (1969). Alcohol and recall: State-dependent effects in man. *Science*, *163*, 1358–1360.

Gordon, R. G., Rigon, A., Covington, N. V., Voss, M., & Duff, M. C. (2019). Higher resting state functional connectivity between the vmPFC and rTPJ in individuals who display conversational synchrony. *Journal of Neurolinguistics*, *51*, 212–220.

Gosling, S. D. (2001). From mice to men: What can we learn about personality from animal research? *Psychological Bulletin*, *127*, 45–86.

Gosling, S. D. (2008). *Snoop: What your stuff says about you*. New York: Basic Books.

Gosling, S. D., Ko, S. J., Mannarelli, T., & Morris, M. E. (2002). A room with a cue: Personality judgments based on offices and bedrooms. *Personality Processes and Individual Differences*, *82*, 379–398.

Gosselin, N., Peretz, I., Noulhiane, M., Hasboun, D., Beckett, C., ... Samson, S. (2005). Impaired recognition of scary music following unilateral temporal lobe excision. *Brain*, *128*, 628–640.

Gottesman, I. (1991). *Schizophrenia genesis*. New York: W. H. Freeman.

Gottesman, I., & Gould, T. D. (2003). The endophenotype concept in psychiatry: Etymology and strategic intentions. *American Journal of Psychiatry*, *160*, 636–645.

Gottfredson, L. S. (2003). On Sternberg's "Reply to Gottfredson." *Intelligence*, *31*, 415–424.

Gottfredson, L. S. (2005). What if the hereditarian hypothesis is true? *Psychology, Public Policy, and Law*, *11*, 311–319.

Gottfredson, L. S., & Deary, I. J. (2004). Intelligence predicts health and longevity, but why? *Current Directions in Psychological Science*, *13*, 1–4.

Gottlieb, B. H., Still, E., & Newby-Clark, I. R. (2007). Types and precipitants of growth and decline in emerging adulthood. *Journal of Adolescent Research*, *22*, 1–24.

Gottman, J. M., & Levenson, R. W. (1992). Marital processes predictive of later dissolution: Behavior, physiology and health. *Journal of Personality and Social Psychology*, *63*, 221–233.

Gottman, J., & Levenson, R. W. (2002). A two-factor model for predicting when a couple will divorce: Exploratory analyses using 14-year longitudinal data. *Family Process*, *41*, 83–96.

Gottschall, H., & Garcia-Bayonas, M. (2008). Student attitudes towards group work among undergraduates in business administration, education and mathematics, *Educational Research Quarterly*, *32*, 3–29.

Gouin, J. P., Zhou, Q. Q., Booij, L., Boivin, M., Côté, S. M., Hébert, M., … Vitaro, F. (2017). Associations among oxytocin receptor gene (OXTR) DNA methylation in adulthood, exposure to early life adversity, and childhood trajectories of anxiousness. *Scientific Reports*, *7*, 7446.

Gouin, J.-P., & Kiecolt-Glaser, J. K. (2011). The impact of psychological stress on wound healing: Methods and mechanisms. *Immunology and Allergy Clinics of North America*, *31*, 81–93.

Gouin, J.-P., Carter, C. S., Pournajafi-Nazarloo, H., Glaser, R., Malarkey, W. B., Loving, T. J., et al. (2010). Marital behavior, oxytocin, vasopressin, and wound healing. *Psychoneuroendocrinology*, *35*, 1082–1090.

Gould, M. S., Greenberg, T., Velting, D. M., & Shaffer, D. (2003). Youth suicide risk and preventive interventions: A review of the past 10 years. *Journal of the American Academy of Child and Adolescent Psychiatry*, *42*, 386–405.

Gould, S. J. (1981). *The mismeasure of man*. New York: W. W. Norton.

Gourley, S. L., Zimmerman, K. S., Allen, A. G., & Taylor, J. R. (2016). The medial orbitofrontal cortex regulates sensitivity to outcome value. *Journal of Neuroscience*, *36*, 4600–4613.

Government of Canada (2018). Ecstasy. Retrieved from www.canada.ca/en/health-canada/services/substance-use/controlled-illegal-drugs/ecstasy.html

Government of Canada. (2006). *The human face of mental health and mental illness in Canada 2006*. Retrieved from www.phac-aspc.gc.ca/publicat/human-humain06/pdf/human_face_e.pdf

Government of Canada. (2012). *Canada Health Act Annual Report 2011-2012*. Retrieved from www.canada.ca/en/health-canada/services/health-care-system/reports-publications/canada-health-act-annual-reports/report-2011-12.html

Government of Canada. (2018). *Ecstasy*. Retrieved from www.canada.ca/en/health-canada/services/substance-use/controlled-illegal-drugs/ecstasy.html

Government of Canada. (2019). *National Report: Apparent Opioid-related Deaths in Canad*a. Retrieved from https://health-infobase.canada.ca/datalab/national-surveillance-opioid-mortality.html#AORD

Grabner, R. H., Stern, E., & Neubauer, A. C. (2003). When intelligence loses its impact: Neural efficiency during reasoning in a familiar area. *International Journal of Psychophysiology*, *49*, 89–98.

Grace, A. A. (2016). Dysregulation of the dopamine system in the pathophysiology of schizophrenia and depression. *Nature Reviews Neuroscience*, *17*, 524–532.

Graeff, F. G., Guimaraes, F. S., De Andrade, T. G., & Deakin, J. F. (1996). Role of 5-HT in stress, anxiety, and depression. *Pharmacology, Biochemistry, and Behavior*, *54*, 129–141.

Graf, P., & Schacter, D. L. (1985). Implicit and explicit memory for new associations normal and amnesic subjects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *11*, 501–518.

Graham, E. R., & Burke, D. M. (2011). Aging increases inattentional blindness to the gorilla in our midst. *Psychology and Aging*, *26*, 162–166.

Graham, K., & Wells, S. (2004). Aggression among young adults in the social context of the bar. *Addiction Research and Theory*, *9*, 193–219.

Grahn, J. A. (2009). The role of the basal ganglia in beat perception. *The Neurosciences and Music III—Disorders and Plasticity*, *1169*, 35–45.

Grahn, J. A., & McAuley, J. D. (2009). Neural bases of individual differences in beat perception. *NeuroImage*, *47*, 1894–1903.

Grahn, J. A., & Rowe, J. B. (2009). Feeling the beat: Premotor and striatal interactions in musicians and nonmusicians during beat perception. *Journal of Neuroscience*, *29*, 7540–7548.

Grahn, J. A., & Rowe, J. B. (2013). Finding and feeling the musical beat: Striatal dissociations between detection and prediction of regularity. *Cerebral Cortex*, *23*, 913–921.

Granpeesheh, D., Tarbox, J., & Dixon, D. R. (2009). Applied behavior analytic interventions for children with autism: A description and review of treatment research. *Annals of Clinical Psychiatry*, *21*, 162–173.

Grant, H. M., Bredahl, L. C., Clay, J., Ferrie, J., Groves, J. E., McDorman, T. A., & Dark, V. J. (1998). Context-dependent memory for meaningful material: Information for students. *Applied Cognitive Psychology*, *12*, 617–623.

Gray, J. (1992). *Men are from Mars, women are from Venus*. New York: HarperCollins.

Gray, J. A. (1991). Neural systems, emotion and personality. In J. Madden IV (Ed.), *Neurobiology of learning, emotion and affect*. New York: Raven Press.

Gray, J. A., & McNaughton, N. (2000). *The neuropsychology of anxiety: An enquiry into the functions of the septo-hippocampal system*. New York: Oxford University Press.

Grebe, N. M., Kristoffersen, A. A., Grøntvedt, T. V., Thompson, M. E., Ottesen Kennair, L. E., & Gangestad, S. W. (2017). Oxytocin and vulnerable romantic relationships. *Hormones and Behavior*, *90*, 64–74.

Green, A. E., Fugelsang, J. A., & Dunbar, K. N. (2006). Automatic activation of categorical and abstract analogical relations in analogical reasoning. *Memory & Cognition*, *34*, 1414–1421.

Green, D. M., & Swets, J. A. (1966). *Signal detection theory and psychophysics*. New York: Wiley.

Greenberg, G. (2013). *The book of woe: The DSM and the unmaking of psychiatry*. New York: Blue Rider Press.

Greenberg, J., Solomon, S., & Arndt, J. (2008). A uniquely human motivation: Terror management. In J. Shah and W. Gardner (Eds.), *Handbook of motivation science* (pp. 113–134). New York: Guilford Press.

Greenberg, L. S. (2004). Emotion-focused therapy. *Clinical Psychology & Psychotherapy*, *11*, 3–16.

Greenberg, L., Elliott, R., & Lietaer, G. (1994). Research on experiential psychotherapies. In A. E. Bergin & S. L. Garfield (Eds.), *Handbook of psychotherapy and behavior change* (4th ed., pp. 509–542). New York: Guilford.

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*, 4–27.

Greenwald, A. G., McGhee, D. E., & Schwartz, J. L. K. (1998). Measuring individual differences in implicit cognition: The implicit association test. *Journal of Personality and Social Psychology*, *74*, 1464–1480.

Greenwald, A. G., Spangenberg, E. R., Pratkanis, A. R., & Eskenazi, J. (1991). Double-blind tests of subliminal self-help audiotapes. *Psychological Science*, *2*, 119–122.

Greenwood, C. E., & Winocur, G. (2005). High-fat diets, insulin resistance and declining cognitive function. *Neurobiology of Aging*, *26*, 42–45.

Gregory, W. L., Cialdini, R. B., & Carpenter, K. M. (1982). Self-relevant scenarios as mediators of likelihood estimates and compliance: Does imagining make it so? *Journal of Personality and Social Psychology*, *43*, 89–99.

Greven, C. U., Harlaar, N., Kovas, Y., Chamorro-Premuzic, T., & Plomin, R. (2009). More than just IQ: School achievement is predicted by self-perceived abilities—but for genetic rather than environmental reasons. *Psychological Science*, *20*, 753–762.

Grice, P. (1975). Logic and conversation. In P. Cole & J. Morgan (Eds.), *Syntax and semantics* (p. 3). New York: Academic Press.

Griffin, J. A., Umstattd, M. R., & Usdan, S. (2010). Alcohol use and high-risk sexual behaviour among collegiate women: A review of research on alcohol myopia theory. *Journal of American College Health*, *58*, 523–532.

Griffiths, R. R., Richards, W. A., Johnson, M. W., McCann, U. D., & Jesse, R. (2008). Mystical-type experiences occasioned by psilocybin mediate the attribution of personal meaning and spiritual significance 14 months later. *Journal of Psychopharmacology*, *22*, 621–632.

Grolnick, W. S., & Ryan, R. M. (1989). Parent styles associated with children's self-regulation and competence in school. *Journal of Educational Psychology*, *81*, 143–153.

Gropper, S. S., Simmons, K. P., Gaines, A., Drawdy, K., Saunders, D., ... Connell, L. J. (2009). The freshman 15: A closer look. *Journal of American College Health*, *58*, 223–231.

Gruber, S. A., & Yurgelun-Todd, D. A. (2005). Neuroimaging of marijuana smokers during inhibitory processing: A pilot

investigation. *Cognitive Brain Research*, *23*, 107–118.

Gruber, S. A., Dahlgren, M. K., Sagar, K. A., Gönenç, A., & Lukas, S. E. (2014). Worth the wait: Effects of age of onset of marijuana use on white matter and impulsivity. *Psychopharmacology*, *231*, 1455–1465.

Gruberger, M., Ben-Simon, E., Levkovitz, Y., Zangen, A., & Hendler, T. (2013). Towards a neuroscience of mind-wandering. *Frontiers in Human Neuroscience*, *5*, article 56, 1–11.

Guerra, C. (2017, October 17). *The Economist*, www.economist.com/graphic-detail/2018/10/15/after-a-year-of-metoo-american-opinion-has-shifted-against-victims

Gueter, S., Koban, L, & Wager, T. D. (2017). The cognitive neuroscience of placebo effects: Concepts, predications, and physiology. *Annual Review of Neuroscience*, *40*, 167–188.

Guldin, W. O., & Grusser, O. J. (1998). Is there a vestibular cortex? *Trends in Neuroscience*, *21*, 254–259.

Guliani, H., Sepehri, A., & Serieux, J. (2013). Does the type of provider and the place of residence matter in the utilization of prenatal ultrasonography? Evidence from Canada. *Applied Health Economics and Health Policy*, *11*, 471–484.

Gustaffson, J. E. (1988). Hierarchical models of individual differences in cognitive abilities. In R. J. Sternberg (Ed.), *Advances in the psychology*

of human intelligence, Vol. 4 (pp. 35–71). Hillsdale, NJ: Erlbaum.

Gutchess, A. H., Hedden, T., Ketay, S., Aron, A., & Gabrieli, J. D. (2010). Neural differences in the processing of semantic relationships across cultures. *Social, Cognitive and Affective Neuroscience*, *5*, 254–263.

Guthrie, E. R. (1952). *The psychology of learning*. New York: Harper & Row.

Haber, J., & Jacob, T. (2007). Alcoholism risk moderation by a socio-religious dimension. *Journal of Studies on Alcohol and Drugs*, *68*, 912–922.

Haber, N., Smith, E. R., Moscoe, E., Andrews, K., Audy, R., Bell, W., et al. (2018) Causal language and strength of inference in academic and media articles shared in social media (CLAIMS): A systematic review. *PLoSONE*, *13*, e0196346.

Haddock, G., Zanna, M. P., & Esses, V. M. (1993). Assessing the structure of prejudicial attitudes: The case of attitudes toward homosexuals. *Journal of Personality and Social Psychology*, *65*, 1105–1118.

Hadland, S. E., Cerdá, M., Li, Y., Krieger, M. S., & Marshall, B. D. L. (2018). Association of pharmaceutical industry marketing of opioid products to physicians with subsequent opioid prescribing. *Journal of the American Medical Association – Internal Medicine*, *178*, 861–863.

Hahn, A., Kranz, G. S., Küblböck, M., Kaufmann, U., Ganger, S., ... Lanzenberger, R. (2015). Structural connectivity networks of transgender people. *Cerebral Cortex*, *25*, 3527–3534.

Hahn, C., Cowell, J. M., Wiprzycka, U. J., Goldstein, D., Ralph, M., Heasher, L., & Zelazo, P. D. (2012). Circadian rhythms in executive function during the transition to adolescence: The effect of synchrony between chronotype and time of day. *Developmental Science*, *15*, 408–416.

Haidt, J. (2001). The emotional dog and its rational tail: A social intuitionist approach to moral judgment. *Psychological Review*, *108*, 814–834.

Haier, R. J., Jung, R., Yeo, R. A., Head, K., & Alkire, M. T. (2005). The neuroanatomy of general intelligence: Sex matters. *NeuroImage*, *25*, 320–327.

Haier, R. J., Siegel, B. V., Tang, C., Abel, L., & Buchsbaum, M. S. (1992). Intelligence and changes in regional cerebral glucose metabolic rate following learning. *Intelligence 16*, 415–426.

Hakuta, K., Bialystok, E., & Wiley, E. (2003). Critical evidence: A test of the critical-period hypothesis for second-language acquisition. *Psychological Science*, *14*, 31–38.

Halberg, F., Peterson, R. E., & Silber, R. H. (1959). Phase relations of 24-hour periodicities in blood corticosterone, mitoses in cortical

adrenal parenchyma and total body activity. *Endocrinology*, *64*, 222–230.

Haldeman, D. C. (2002). Gay rights, patient rights: The implications of sexual orientation conversion therapy. *Professional Psychology: Research and Practice*, *33*, 260–264.

Halgren, E., Raij, T., Marinkovic, K., Jousmäki, V., & Hari, R. (2000). Cognitive response profile of the human fusiform face area as determined by MEG. *Cerebral Cortex*, *10*, 69–81.

Hall, D., & Buzwell, S. (2012). The problem of free-riding in group projects: Looking beyond social loafing as reason for non-contribution. *Active Learning in Higher Education*, *14*, 37–49.

Hall, G. S. (1904). *Adolescence* (Vols. 1 & 2). New York: Appleton.

Halpern-Fisher, B. L., Cornell, J. L., Kropp, R. Y., & Tschann, J. M. (2005). Oral versus vaginal sex among adolescents: Perceptions, attitudes, and behavior. *Pediatrics*, *4*, 845–851.

Halpern, D. F. (1996). *Thought and knowledge: An introduction to critical thinking*. Mahwah, NJ: Lawrence Erlbaum.

Halpern, D. F., & Lamay, M. L. (2000). The smarter sex: A critical review of sex differences in intelligence. *Educational Psychology Review*, *12*, 229–246.

Halpern, J. H., & Pope, H. G. (2003). Hallucinogen persisting perception disorder: What do we know after 50 years? *Drug and Alcohol Dependence*, *69*, 109–119.

Hamalainen, M. S., Hari, R., Ilmoniemi, R., Knuutila, J., & Lounasmaa, O. (1993). Magnetoencephalography —Theory, instrumentation, and applications to noninvasive studies of the working human brain. *Reviews of Modern Physics*, *65*, 413–497.

Hammond, D. (2011). Health warning messages on tobacco products: A review. *Tobacco Control*, *20*, 327–337.

Hammond, D., Ahmed, R., Burkhalter, R., Sae Yang, W., & Leatherdale, S. (2010). Illicit substance use among Canadian youth: Trends between 2002 and 2008. *Canadian Journal of Public Health*, *102*, 7–12.

Hammond, D., Fong, G. T., Borland, R., Cummings, K. M., McNeill, A., & Driezen, P (2007). Communicating risk to smokers: The impact of health warnings on cigarette packages. *American Journal of Preventive Medicine*, *32*, 202–209.

Hammond, D., Fong, G. T., McDonald, P. W., Cameron, R., & Brown, K. S. (2003). Impact of the graphic Canadian warning labels on adult smoking behavior. *Tobacco Control*, *12*, 391–395.

Hanin, Y. L. (2000). *Emotions in sport*. Champaign, IL: Human Kinetics.

Hardwick, S., & King, L. (2008). *Home Office cannabis potency study 2008*. Sandridge, U.K.: Home Office Scientific Development Branch.

Hare, R. D. (1985). Comparison of procedures for the assessment of psychopathy. *Journal of Consulting and Clinical Psychology*, *53*, 7–16.

Hare, R. D. (2003). *Psychopathy checklist-revised technical manual* (2nd ed.). Toronto: Multihealth Systems, Inc.

Harlow, J. M. (1848). Passage of an iron rod through the head. *Boston Medical and Surgical Journal*, *39*, 389–393.

Harlow, J. M. (1849). Letter in "medical miscellany." *Boston Medical and Surgical Journal*, *39*, 506–507.

Harlow, J. M. (1868). Recovery from the passage of an iron bar through the head. *Publications of the Massachusetts Medical Society*, *2*, 327–347.

Harrigan K., MacLaren, V., Brown, D., Dixon, M. J., & Livingstone, C. (2014). Games of chance or masters of illusion: Multiline slots design may promote cognitive distortions. *International Gambling Studies*, *14*, 301–317.

Harris, C.R., Coburn, N., Rohrer, D., & Pashler, H. (2013). Two failures to replicate high-performance-goal priming effects. *PLOS One*, *8*, e72467

Harris, J. L., Bargh, J. A., & Brownell, K. D. (2009). Priming effects of television food advertising on eating behavior. *Health Psychology*, *28*, 404–413.

Harris, J. L., Pierce, M., & Bargh, J. A. (2013). Priming effect of antismoking PSAs on smoking behavior: A pilot study. *Tobacco Control*, *23*, 285–290.

Harris, R. B. (1990). Role of set-point theory in regulation of body weight. *The Journal of the Federation of American Societies for Experimental Biology*, *4*, 3310–3318.

Harrison, G., Hopper, K., Craig, T., Laska, E., Siegel, C., ... Wiersma, D. (2001). Recovery from psychotic illness: a 15- and 25-year international follow-up study. *British Journal of Psychiatry*, *178*, 506–517.

Hart, B., & Risley, T. R. (1995). *Meaningful differences in the everyday experience of young American children*. Baltimore: Paul H. Brookes.

Hartgerink, C. H. J., van Beest, I., Wicherts, J. M., & Williams, K. D. (2015). The ordinal effects of ostracism: A meta-analysis of 120 cyberball studies. *PLoS ONE*, *10,* e0127002.

Hartline, D. K., & Colman, D. R. (2007). Rapid conduction and the evolution of giant axons and myelinated fibers. *Current Biology*, *17*, R29–35.

Hartman, E., & Brezler, T. (2008). A systematic change in dreams after 9/11/01. *Sleep*, *31*, 213–218.

Harvey, P., & Walker, E. (Eds.). (1987). *Positive and negative symptoms of psychosis: Description, research, and future directions*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Haselton, M. G., Mortezaie, M., Pillsworth, E. G., Bleske-Rechek, A., & Frederick, D. A. (2007). Ovulatory shifts in human female ornamentation: Near ovulation, women dress to impress. *Hormones and Behavior*, *51*, 40–45.

Hasher, L., Chung, C., May, C. P., & Foong, N. (2002). Age, time of testing, and proactive interference. *Canadian Journal of Experimental Psychology*, *56*, 200–207.

Hashmani, N., Hashmani, S., Ramesh, P, Rajani, H, Ahmed, J., Kumar, … Jamali, M. (2017). A comparison of visual outcomes and patient satisfaction between photorefractive keratectomy and femtosecond laser-assisted in situ keratomileusis. *Cureus*, *9*, e1641.

Haslam, S. A., & Reicher, S. D. (2012). Contesting the "nature" of conformity: What Milgram and Zimbardo's studies really show. *PLoS Biol 10*, e1001426.

Hatfield, E., & Rapson, R. L. (2009). The neuropsychology of passionate love and sexual desire. In E. Cuyler, & M. Ackart (Eds.), *Psychology of social relationships*. Hauppauge, NY: Nova Science.

Hauen, J. (2018, September 4). The differences between Ontario's interim sex-ed curriculum and 2015's. *The Globe & Mail*. www.theglobeandmail.com/canada/article-the-differences-between-ontarios-interim-sex-ed-curriculum-and-2015s/

Hawkins, R. D. (1984). A cellular mechanism of classical conditioning in *aplysia*. *Journal of Experimental Biology*, *112*, 113–128.

Hawkley, L. C., Burleson, M. H., Berntson, G. G., & Cacioppo, J. T. (2003). Loneliness in everyday life: Cardiovascular activity, psychosocial context, and health behaviors. *Journal of Personality & Social Psychology*, *85*, 105–120.

Hayes, J., Schimel, J., Arndt, J., & Faucher, E. H. (2010). A theoretical and empirical review of the death-thought accessibility concept in terror management theory. *Psychological Bulletin*, *136*, 699–739.

Hayes, K. J., & Hayes, C. (1951). The intellectual development of a home-raised chimpanzee. *Proceedings of the American Philosophical Society*, *95*, 105–109.

Hayes, S. C., Luoma, J. B., Bond, F. W., Masuda, A., & Lillis, J. (2006). Acceptance and commitment therapy: Model, processes and outcomes. *Behaviour Research and Therapy*, *44*, 1–25.

Hayne, H., Herbert, J., & Simcock, G. (2003). Imitation from television by 24- and 30-month-olds. *Developmental Science*, *6*, 254–261.

Hazan, C., & Shaver, P. R. (1987). Romantic love conceptualized as an attachment process. *Journal of Personality and Social Psychology*, *52*, 511–524.

Hazell, P. (2007). Drug therapy for attention-deficit/hyperactivity disorder-like symptoms in autistic disorder. *Journal of Paediatrics and Child Health*, *43*, 19–24.

He, C., Hotson, L., & Trainor, L. J. (2007). Mismatch responses to pitch changes in early infancy. *Journal of Cognitive Neuroscience*, *19*, 878–892.

He, C., Hotson, L., & Trainor, L. J. (2009). Development of infant mismatch responses to auditory pattern changes between 2 and 4 months old. *European Journal of Neuroscience*, *29*, 861–867.

Health Canada. (2008). Canadian tobacco use monitoring survey (CTUMS). Retrieved from www.hc-sc.gc.ca/hc-ps/tobac-tabac/research-recherche/stat/ctums-esutc_2008-eng.php

Health Canada. (2010). Canadian alcohol and drug use monitoring survey: Summary of results for 2009. Retrieved from www.hc-sc.gc.ca/hc-ps/drugs-drogues/stat/_2009/summary-sommaire-eng.php

Health Canada. (2012). *Canadian Community Health Survey: Mental Health 2012*. Retrieved from www150.statcan.gc.ca/n1/daily-quotidien/130918/dq130918a-eng.htm

Heart and Stroke Foundation of Canada. (2013). *Statistics*. Retrieved from www.heartandstroke.com/site/c.ikIQLcMWJtE/b.3483991/k.34A8/Statistics.htm

Heath, C., & Heath, D. (2007). *Made to stick: Why some ideas survive and others die*. New York: Random House.

Heatherton, T. F., & Sargent, J. D. (2009). Does watching smoking in movies promote teenage smoking? *Current Directions in Psychological Science*, *18*, 63–67.

Heatherton, T. F., & Weinberger, J. L. (Eds.). (1994). *Can personality change?* Washington, DC: American Psychological Association.

Hebb, D. O. (1947). The effects of early experience on problem solving at maturity. *American Psychologist*, *2*, 306–307.

Hebb, D. O. (1949). *Organization of behavior: A neuropsychological theory*. New York: John Wiley.

Heidenreich, M., & Zhang, F. (2016). Applications of CRISPR-Cas systems in neuroscience. *Nature Reviews Neuroscience*, *17*, 36–44.

Heider, F. (1958). *The psychology of interpersonal relations*. New York: Wiley.

Heilman, K. M., & Valenstein, E. (1979). Mechanisms underlying hemispatial neglect. *Annals of Neurology*, *5*, 166–170.

Heine, S. J. (2003). An exploration of cultural variation in self-enhancing and self-improving motivations. In V. Murphy-Berman & J. J. Berman (Eds.), *Nebraska symposium on motivation: Vol. 49. Cross-cultural differences in perspectives on the self* (pp. 101–128). Lincoln: University of Nebraska Press.

Heine, S. J., & Buchtel, E. E. (2009). Personality: The universal and the culturally specific. *Annual Review of Psychology*, *60*, 369–394.

Heine, S. J., Lehman, D. R., Ide, E., Leung, C., Kitayama, S., ... Matsumoto, H. (2001). Divergent consequences of success and failure in Japan and North America: An investigation of self-improving motivations and malleable selves. *Journal of Personality and Social Psychology*, *81*, 599–615.

Heinrichs, M., Baumgartner, T., Kirchbaum, C., & Ehlert, U. (2003). Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. *Biological Psychiatry*, *54*, 1389–1398.

Heinz, A., & Schlagenhauf, F. (2010). Dopaminergic dysfunction in schizophrenia: Salience attribution revisited. *Schizophrenia Bulletin*, *36*, 472–485.

Helm, K., Viol, K., Weiger, T. M., Tass, P. A., Grefkes, C., Monte, D., & Schiepek, G. (2018). Neuronal connectivity in major depressive disorder: A systematic review. *Neuropsychiatric Disease and Treatment*, *14*, 2715–2737.

Hendrick, C., Hendrick, S. S., & Reich, D. A. (2006). The brief sexual attitudes scale. *Journal of Sex Research*, *43*, 76–86.

Hendrickson, A. E., Wagoner, N., & Cowan, M. (1972). An autoradiographic and electron microscopic study of retino-hypothalamic connections. *Zeitschrift für Zellforschung und Mikroskopische Anatomie*, *135*, 1–26.

Henley, C. L., Nunez, A. A., & Clemens, L. G., (2011). Hormones of choice: The neuroendocrinology of partner preference in animals. *Frontiers in Neuroendocrinology*, *32*, 146–154.

Henrich, J., Heine, S. J., & Norenzayan, A. (2010) The weirdest people in the world? *Behavioral and Brain Sciences*, *33*, 61–135.

Henssler, J., Brandt, L., Müller, M., Liu, S., Montag, C., Sterzer, P., & Heinz, A. (2019). Migration and schizophrenia : meta-analysis and explanatory framework. *European Archives of Psychiatry and Clinical Neuroscience*. Epub ahead of print.

Herd, D. (2009). Changing images of violence in rap music lyrics: 1979–1997. *Journal of Public Health Policy*, *30*, 395–406.

Herlitz, J., Wiklund, I., Caidahl, K., Hartford, M., Haglid, M., & Karlsson, B. W. (1998). The feeling of loneliness prior to coronary artery bypass grafting might be a predictor of short- and long-term postoperative mortality. *European Journal of Vascular and Endovascular Surgery*, *16*, 120–125.

Herman-Giddens, M. E., Slora, E. J., Wasserman, R. C., Bourdony, C. J., Bhapkar, M. V., ... Hasemeier, C. M. (1997). Secondary sexual characteristics and menses in young girls seen in office practice: A study from the Pediatric Research in Office Settings network. *Pediatrics*, *99*, 505–512.

Herman, C. P. (2015). The social facilitation of eating. A review. *Appetite*, *85*, 61–73.

Herman, C. P., Roth, D. A., & Polivy, J. (2003). Effects of the presence of others on food intake: A normative interpretation. *Psychological Bulletin*, *129*, 873–886.

Hermann, D., Sartorius, A., Welzel, H., Walter, S., Skopp, G., Ende, G., & Mann, K. (2007). Dorsolateral prefrontal cortex N-Acetylaspartate/total creatine (NAA/tCr) loss in male recreational cannabis users. *Biological Psychiatry*, *61*, 1281–1289.

Hermans, E. J., Putman, P., Baas, J. M., Koppeschaar, H. P., & van Honk, J. (2006). A single administration of testosterone reduces fear-potentiated startle in humans. *Biological Psychiatry*, *59*, 872–874.

Hernandez-Reif, M., Diego, M., & Field, T. (2007). Preterm infants show reduced stress behaviors and activity after 5 days of massage therapy. *Infant Behavior and Development*, *30*, 557–561.

Hernandez, A. E., & Li, P. (2007). Age of acquisition: Its neural and computational mechanisms. *Psychological Bulletin*, *133*, 638–650.

Hernández, S. E., Barros-Loscertales, A., Xiao, Y., González-Mora, J. L., & Rubia, K. (2018). Gray matter and functional connectivity in anterior cingulate cortex are associated with the state of mental silence during Sahaja yoga meditation. *Neuroscience*, *371*, 395–406.

Herrnstein, R., & Murray, C. (1994). *The bell curve: Intelligence and class structure in American life*. New York: Free Press.

Hershkowitz, I., Orbach, Y., Lamb, M. E., Sternberg, K. J., Horowitz, D., & Hovav, M. (1998). Visiting the scene of the crime: Effects on children's recall of alleged abuse. *Legal and Criminological Psychology*, *3*, 195–207.

Hetherington, E. M., Bridges, M., & Insabella, G. M. (1998). What matters? What does not? Five perspectives on the association between marital transitions and children's adjustment. *American Psychologist*, *53*, 167–184.

Heyes, C. M., & Galef, B. G. Jr. (Eds.). (1996). *Social learning in animals: The roots of culture*. San Diego: Academic Press.

Higley, J. D., Mehlman, P. T., Poland, R. E., Taub, D. M., Vickers, J., ... Linnoila, M. (1996). CSF testosterone and 5-HIAA correlate with different types of aggressive behaviors. *Biological Psychiatry*, *40*, 1067–1082.

Hilgard, E. R (1986). *Divided consciousness: Multiple controls in human thought and action*. New York: Wiley.

Hill, K. E., Mann, L., Laws, K. R., Stippich, C., & Schröder, J. (2004). Hypofrontality in schizophrenia: A meta-analysis of functional imaging studies. *Acta Psychiatrica Scandinavica*, *110*, 243–256.

Hill, S. Y., Schwin, R., Powell, B., & Goodwin, D. W. (1973). State-dependent effects of marihuana on human memory. *Nature*, *243*, 241–242.

Hillary, F. G., Schultheis, M.T., Challis, B. H., Millis, S. R., Carnevale, G. J., Galshi, T., & Deluca, J. (2003). Spacing of repetitions improves learning and memory after moderate and severe TBI. *Journal of Clinical Experimental Neuropsychology*, *25*, 49–58.

Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. *Nature Reviews Neuroscience*, *9*, 58–65.

Hillman, C. H., Snook, E. M., & Jerome, G. J. (2003). Acute cardiovascular exercise and executive control function. *International Journal of Psychophysiology*, *48*, 307–314.

Himmelheber, A. M., Sarter, M., & Bruno, J. P. (2000). Increases in cortical acetylcholine release during sustained attention performance in rats. *Cognitive Brain Research*, *9*, 313–325.

Hinds, J., & Joinson, A. (2019). Human and computer personality prediction from digital footprints. *Current Directions in Psychological Science*, *28*, 204–211.

Hingson, R. W., Zha, W., & Weitzman, E. R. (2009). Magnitude of and trends in alcohol-related mortality and morbidity among U.S. college students ages 18–24, 1998–2005. *Journal of Studies on Alcohol and Drugs*, *16* (suppl), 12–20.

Hirsh-Pasek, K., Zosh, J. M., Golinkoff, R .M., Gray, J. H., Robb, M. B., & Kaufman, J. (2015). Putting education in "educational" apps: lessons from the science of learning. *Psychological Science in the Public Interest*, *16*, 3–34.

Hirsh, J. B. (2010). Personality and environmental concern. *Journal of Environmental Psychology*, *30*, 245–248.

Hirsh, J. B., & Dolderman, D. (2007). Personality predictors of consumerism and environmentalism: A preliminary study. *Personality and Individual Differences*, *43*, 1583–1593.

Hirst, W., & Phelps, E. A. (2016). Flashbulb Memories. *Current directions in psychological science*, *25*, 36–41.

Hirst, W., Phelps, E., Buckner, R., Budson, A., Cuc, A., Gabrieli, J., et al. (2009). Long-term memory for the terrorist attack of September 11: Flashbulb memories, event memories, and the factors that influence their retention. *Journal of Experimental Psychology: General*, *138*, 161–176.

Hobson, J. A., & McCarley, R. W. (1977). The brain as a dream state generator: An activation-synthesis hypothesis of the dream process.

The American Journal of Psychiatry, *134*, 1335–1348.

Hobson, J., Pace-Schott, E., & Stickgold, R. (2000). Dreaming and the brain: Toward a cognitive neuroscience of conscious states. *Behavioral and Brain Sciences*, *23*, 793–842.

Hodges, L. F., Anderson, P., Burdea, G. C., Hoffman, H. G., & Rothbaum, B. O. (2001). VR as a tool in the treatment of psychological and physical disorders. *IEEE Computer Graphics and Applications*, *21*, 25–33.

Hodges, N. J., Williams, A. M., Hayes, S. J., & Breslin, G. (2007). What is modelled during observational learning? *Journal of Sport Sciences*, *25*, 531–545.

Hodgkin, A. L. (1937). Evidence for electrical transmission in nerve. *Journal of Physiology*, *90*, 183–210.

Hoffman, M. L., & Saltzstein, H. D. (1967). Parent discipline and the child's moral development. *Journal of Personality and Social Psychology*, *5*, 45–57.

Hofmann, S. G., & Smits, J. A. J. (2008). Cognitive-behavioral therapy for adult anxiety disorders: A meta-analysis of randomized placebo-controlled trials. *Journal of Clinical Psychiatry*, *69*, 621–632.

Hoffman, S. G., Grossman, P., & Hinton, D. E. (2011). Loving-kindness and compassion meditation: Potential for psychological

interventions. *Clinical Psychology Review*, *31*, 1126–1132.

Hofschire, L. J., & Greenberg, B. S. (2002). Media's impact on adolescents' body dissatisfaction. In J. D. Brown, J. R. Steele., & K. Walsh-Childers (Eds.), *Sexual teens, sexual media*. Mahwah, NJ: Lawrence Erlbaum Associates.

Hofstede, G. (1984). The cultural relativity of the quality of life concept. *Academy of Management Review*, *9*, 389–398.

Hogan, M. J., Kelly, C. A. M., Verrier, D., Newell, J., Hasher, L., & Robertson, I. H. (2009). Optimal time-of-day and consolidation of learning in younger and older adults. *Experimental Aging Research*, *35*, 107–128.

Hojnoski, R. L., Morrison, R., Brown, M., & Matthews, W. J. (2006). Projective test use among school psychologists: A survey and critique. *Journal of Psychoeducational Assessment*, *24*, 145–159.

Holleran, S. E., Mehl, M. R., & Levitt, S. (2009). Eavesdropping on social life: The accuracy of stranger ratings of daily behavior from thin slices of natural conversations. *Journal of Research in Personality*, *43*, 660–672.

Hollerman, J. R., & Schultz, W. (1996). Activity of dopamine neurons during learning in a familiar task context. *Society for Neuroscience Abstracts*, *22*, 1388.

Hollon, S. D., Stewart, M. O., & Strunk, D. (2006). Enduring effects for cognitive behavior therapy in the treatment of depression and anxiety. *Annual Review of Psychology*, *57*, 285–315.

Hollon, S., Thase, M., & Markowitz, J. (2002). Treatment and prevention of depression. *Psychological Science in the Public Interest*, *3*, 39–77.

Holmes, T. H., & Rahe, R. H. (1967). The social readjustment rating scale. *Journal of Psychosomatic Research*, *11*, 213–218.

Holyoak, K. J., & Morrison R. G. (2005). Thinking and reasoning: A reader's guide. In K. J. Holyoak & R. G. Morrison (Eds.), *The Cambridge handbook of thinking and reasoning* (pp. 1–9). New York: Cambridge University Press.

Holzman, D. C. (2010). What's in a color? The unique human health effect of blue light. *Environmental Health Perspectives*, *118*, A22–A27.

Hooker, W. D., & Jones, R.T. (1987). Increased susceptibility to memory intrusions and the Stroop interference effect during acute marijuana intoxication. *Psychopharmacology*, *91*, 20–24.

Hooley, J. (2007). Expressed emotion and relapse of psychopathology. *Annual Review of Clinical Psychology*, *3*, 329–352.

Hooley, J. M., & Gotlib, I. H. (2000). A diathesis-stress conceptualization of expressed emotion and clinical outcome. *Journal of Applied and Preventive Psychology*, *9*, 135–151.

Hooven, C. K., Chabris, C. F., Ellison, P. T., & Kosslyn, S. M. (2004). The relationship of male testosterone to components of mental rotation. *Neuropsychologia*, *42*, 782–790.

Hopkins, B., & Westra, T. (1989). Maternal expectations of their infants' development: Some cultural differences. *Developmental Medicine and Child Neurology*, *31*, 384–390.

Horn, J. L., & Cattell, R. B. (1967). Age differences in fluid and crystallized intelligence. *Acta Psychologica*, *26*, 107–129.

Horn, L. R., & Ward, G. (2004). *The handbook of pragmatics*. Malden, MA: Blackwell.

Horne, P. J., & Erjavec, M. (2007). Do infants show generalized imitation of gestures? *Journal of the Experimental Analysis of Behavior*, *87*, 63–87.

Horvath, A. O., & Bedi, R. P. (2002). The alliance. In J. C. Norcross (Ed.), *Psychotherapy relationships that work: Therapist contributions and responsiveness to patients* (pp. 37–69). New York: Oxford University Press.

Hoshino-Browne, E., Zanna, A. S., Spencer, S. J., Zanna, M. P., Kitayama, S., & Lackenbauer, S. (2005). On the cultural guises of cognitive dissonance: The case of easterners and westerners. *Journal of Personality and Social Psychology*, *89*, 294–310.

Hough, W., & O'Brien, K. (2005). The effect of community treatment orders on offending rates. *Psychiatry, Psychology and Law*, *12*, 411–423.

Hounsfield, G. N. (1980). Computed medical imaging. *Medical Physics*, *7*, 283–291.

Houts, A. C. (2000). Fifty years of psychiatric nomenclature: Reflections on the 1943 War Department Technical Bulletin, Medical 203. *Journal of Clinical Psychology*, *56*, 935–967.

Howard, A. L., Patrick, M. E., & Maggs, J. L. (2015). College student affect and heavy drinking: Variable associations across days, semesters, and people. *Psychology and Addictive Behaviors*, *29*, 430–443.

Howe, M. L. (2003). Memories from the cradle. *Current Directions in Psychological Science*,*12*, 62–65.

Hrobjartsson, A., & Gotzsche, P. (2010). Placebo interventions for all clinical conditions. *Cochrane Database of Systematic Reviews*, *1*, CD003974.

Hsu, P. D., Lander, E. S., & Zhang, F. (2014). Development and applications of CRISPR-Cas9 for genome engineering. *Cell*, *157*, 1262–1278.

Huang, C. (2012). Outcome-based observational learning in human infants. *Journal of Comparative Psychology*, *126*, 139–149.

Huang, Y., Kendrick, K. M., & Yu, R. (2014). Conformity to the opinions of other people lasts for no more than 3 days. *Psychological Science*, *25*, 1388–1393.

Hubel, D. H., & Weisel, T. N. (1959). Receptive fields of single neurons in the cat's striate cortex. *Journal of Physiology*, *148*, 574–591.

Hubel, D. H., & Wiesel, T. N. (1962). Receptive fields, binocular interaction and functional architecture in the cat's visual cortex. *Journal of Physiology*, *160*, 106–154.

Hudson, J., Hiripi, E., Pope, H., & Kessler, R. (2007). The prevalence and correlates of eating disorders in the National Comorbidity Survey replication. *Biological Psychiatry*, *61*, 348–358.

Huesmann, L. R. (2007). The impact of electronic media violence: Scientific theory and research. *Journal of Adolescent Health*, *41*, S6–S13.

Huettel, S. A., Song, A. W., & McCarthy, G. (2009). *Functional magnetic resonance imaging* (2nd ed.). Sunderland, MA: Sinauer Associates, Inc.

Huffman, M. A. (1996). Acquisition of innovative cultural behaviors in nonhuman primates: A case study of stone handling, a socially transmitted behavior in Japanese macaques. In C. M. Heyes & B. Galef (Eds.), *Social learning in animals: The roots of culture* (pp. 267–289). San Diego: Academic Press.

Hughes, C. E., & Stevens, A. (2010). What can we learn from the Portuguese decriminalization of illegal drugs? *British Journal of Criminology*, *50*, 999–1022.

Hughlings Jackson, J. (1876/1932). Case of large cerebral tumour without optic neuritis and with hemiplegia and imperceptions. In J. Taylor (Ed.), *Selected writings of John Hughlings Jackson* (pp. 146–152). London: Hodder and Stoughton.

Hughto, J. M. W., Reisner, S. L., & Pachankis, J. E. (2015). Transgender stigma and health: A critical review of stigma determinants, mechanisms, and interventions. *Social Science & Medicine*, *147*, 222–231.

Hunter, J. E., & Hunter, R. F. (1984). Validity and utility of alternative predictors of job performance. *Psychological Bulletin*, *96*, 72–98.

Hunter, R. A., & Macalpine, I. (Eds.). (1963). *Three hundred years of psychiatry, 1535–1860: A history presented in selected English texts*. New York: Oxford University Press.

Hursh, A., Tsukamoto, Y., Smith, R. G., & Sterling, P. (1939). Conduction velocity and diameter of nerve fibers. *American Journal of Physiology*, *127*, 131–139.

Huston, T. L., Ruggiero, M., Conner, R., & Geis, G. (1981). Bystander intervention into crime: A study based on naturally-occurring episodes. *Social Psychology Quarterly*, *44*, 14–23.

Hvistendahl, M. (2018). China's bioethics struggles enter the spotlight. *Slate*. Retrieved from https://slate.com/technology

Hwang, W.-C., Lin, K., Cheung, F., & Wood, J. (2006). Cognitive-behavioral therapy with Chinese Americans: Research, theory, and clinical practice. *Cognitive and Behavioral Practice*, *13*, 293–303.

Hwang, W.-C., Myers, H. F., Abe-Kim, J., & Ting, J. Y. (2008). A conceptual paradigm for understanding culture's impact on mental health: The cultural influences on mental health (CIMH) model. *Clinical Psychology Review*, *28*, 211–227.

Hyde, J., Mezulis, A., & Abramson, L. (2008). The ABCs of depression: Integrating affective, biological, and cognitive models to explain the emergence of the gender difference in depression. *Psychological Review*, *115*, 291–313.

Hyde, K. L., Peretz, I., & Zatorre, R. J. (2008). Evidence for the role of the right auditory cortex in fine pitch resolution. *Neuropsychologia*, *46*, 632–639.

Hysek, C. M., Simmler, L. D., Ineichen, M., Grouzmann, E., Hoener, M. C., ... Liechti, M. E. (2011). The norepinephrine transporter inhibitor reoxetine reduces the stimulant effects of MDMA ("ecstasy") in humans. *Clinical Pharmacology and Therapeutics*, *90*, 246–255.

Iacoboni, M., Molnar-Szakacs, I., Gallese V., Buccino, G., Mazziotta, F. C., & Rizzolatti, G. (2005). Grasping the intentions of others with one's own mirror neuron system. *PLoS Biology*, *3*, e79.

Inlow, J. K., & Restifo, L. L. (2004). Molecular and comparative genetics of mental retardation. *Genetics*, *166*, 835–881.

Isbell, L. A. (2006) Snakes as agents of evolutionary change in primate brains. *Journal of Human Evolution*, *51*, 1–35.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52*, 112–1131.

Isenberg, D. J. (1986). Group polarization: A critical review and meta-analysis. *Journal of Personality and Social Psychology*, *50*, 1141–1151.

Isometsä, E. (2014). Suicidal behaviour in mood disorders—who, when, and why? *Canadian Journal of Psychiatry*, *59*, 120–130.

Ito, T. A., & Urland, G. R. (2003). Race and gender on the brain: Electrocortical measures of attention to the race and gender of multiply categorizable individuals. *Journal of Personality and Social Psychology*, *85*, 616–626.

Iyengar, S. S., Wells, R. E., & Schwartz, B. (2006). Doing better but feeling worse: Looking for the "best" job undermines satisfaction. *Psychological Science*, *17*, 143–150.

Izard, V., Sann, C., Spelke, E. S., & Streri, A. (2009). Newborn infants perceive abstract numbers. *Proceedings of the National Academy of Sciences*, *106*, 10382–10385.

Jacob, C., Guéguen, N., & Delfosse, C. (2012). She wore something in her hair: The effect of ornamentation on tipping. *Journal of Hospitality Marketing and Management*, *21*, 414–420.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences of the United States of America*, *105*, 6829–6833.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Shah, P. (2011). Short- and long-term benefits of cognitive training. *Proceedings of the National Academy of Sciences of the United States of America*, *108*, 10081–10086.

Jaffee, S., & Hyde, J. S. (2000). Gender differences in moral orientation: A meta-analysis. *Psychological Bulletin*, *126*, 703–726.

Jager, G., Kahn, R. S., Ven Den Brink, W., Van Ree, J. M., & Ramsey, N. F. (2006). Long-term effects of frequent cannibus use on working memory and attention: An fMRI study. *Psychopharmacology*, *185*, 358–368.

Jager, G., Van Kell, H. H., De Win, M. M. L., Kahn, R. S., Van Den brink, W., Van Ree, J. M., & Ramsey, N. F. (2007). Effects of frequent

cannabis use on hippocampal activity during an associative memory task. *European Neuropsychopharmacology*, *17*, 289–297.

Jakobs, D., Hage-Hulsmann, A., Prenner, L., Kolb, C., Weiser, D., & Haberlein H. (2013). Down-regulation of B1-adrenergic receptors in rat C6 glioblastoma cells by hyperforin and hyperoside from St. John's wort. *Journal of Pharmacy and Pharmacology*, *65*, 907–915.

James, T. W., Cullham, J., Humphrey, G. K., Milner, A. D., & Goodale, M. A. (2003). Ventral occipital lesions impair object recognition but not object-directed grasping: An fMRI study. *Brain*, *126*, 2463–2475.

James, W. (1890). *The principles of psychology*. New York: Henry Holt and Company.

Jamieson, G. A., & Sheehan, P. W. (2004). An empirical test of Woody and Bower's dissociated-control theory of hypnosis. *The International Journal of Clinical and Experimental Hypnosis*, *52*, 232–249.

Janis, I. L. (1972). *Victims of groupthink: A psychological study of foreign policy decisions and fiascoes*. Boston: Houghton Mifflin.

Jencks, C., Smith, M., Acland, H., Bane, M. J., Cohen, D., ... Michelson, S. (1972). *Inequality: A reassessment of the effect of family and schooling in America*. New York: Harper & Row.

Jensen, A. R. (1993). Test validity: *g* versus “tacit knowledge.” *Current Directions in Psychological Science*, *2*, 53–56.

Jewanski, J., Day, S. A., & Ward, J. (2009). A colorful albino: The first documented case of synaesthesia, by Georg Tobias Ludwig Sachs in 1812. *Journal of the History of the Neuroscience: Basic and Clinical Perspectives*, *18*, 293–303.

Jha, A. P., Krompinger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. *Cognitive, Affective, and Behavioral Neuroscience*, *7*, 109–119.

Jimenez, D. E., Cook, B., Bartels, S. J., & Alegria, M. (2012). Disparities in mental health service use of racial and ethnic minority elderly adults. *Journal of the American Geriatric Society*, *61*, 18–25.

John, E. R., Chesler, P., Bartlett, F., & Victor, I. (1968). Observational learning in cats. *Science*, *29*, 1489–1491.

Johns, M. W. (1991). A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*, *14*, 540–545.

Johnson, A. M., Reed, T. E., & Vernon, P. A. (2005). Nerve conduction velocity (NCV) is a valid and useful construct for studying human cognitive abilities: A reply to Saint-Amour et al. *Neuropsychologia*, *43*, 1845–1846.

Johnson, B. B. (2012). Climate change communication: A provocative inquiry into motives, meanings, and means. *Risk Analysis*, *32*, 973–991.

Johnson, J. K., Gross, A. L., Pa, J., McLaren, D. G., Park, L. Q., Manly, J. J., & Alzheimer's Disease Neuroimaging Initiative. (2012). Longitudinal change in neuropsychological performance using latent growth models: a study of mild cognitive impairment. *Brain Imaging and Behavior*, *6*, 540–550.

Johnson, K. E., & Mervis, C. B. (1997). Effects of varying levels of expertise on the basic level of categorization. *Journal of Experimental Psychology: General*, *126*, 248–277.

Johnson, M. K., Hashtroudi, S., & Lindsay, D. S. (1993). Source monitoring. *Psychological Bulletin*, *114*, 3–28.

Johnson, M. K., Raye, C. L., Mitchell, K. J., & Ankudowich, E. (2012). The cognitive neuroscience of true and false memories. *Nebraska Symposium on Motivation*, *58*, 15–52.

Johnson, M. W., Garcia-Romeu, A., Cosimano, M. P., & Griffiths, R. R. (2014). Pilot study of the 5-HT2AR agonist psilocybin in the treatment of tobacco addiction. *Journal of Psychopharmacology*, *28*, 983–992.

Johnson, T.A., Cooper, S., Stamper, G.C., & Chertoff, M. (2017). Noise exposure questionnaire (NEQ): A tool for quantifying annual noise exposure. *Journal of the Academy of Audiology*, *28*, 14–35.

Johnson, W., & Bouchard, T. J., Jr. (2007). Sex differences in mental abilities: *g* masks the dimensions on which they lie. *Intelligence*, *35*, 23–39.

Johnson, W., te Nijenhuis, J., & Bouchard, T. (2008). Still just 1 *g*: Consistent results from five test batteries. *Intelligence*, *36*, 81–95.

Johnsrude, I. S., Penhune, V. B., & Zatorre, R. J. (2000). Functional specificity in the right human auditory cortex for perceiving pitch direction. *Brain*, *123*, 155–163.

Jokela, M., & Hanin, Y. L. (1999). Does the individual zones of optimal functioning model discriminate between successful and less successful athletes?: A meta-analysis. *Journal of Sports Science*, *17*, 873–887.

Joling, K. J., van Hout, H. P., Van't Veer-Tazelaar, P. J., van der Horst, H. E., Cuijpers, P., … van Marwijk, H. W. (2011). How effective is bibliotherapy for very old adults with subthreshold depression? Randomized controlled trial. *American Journal of Geriatric Psychiatry*, *19*, 256–265.

Jones, A., Gublis, A., & Baker, E. H. (2010). Differences in tobacco use between Canada and the United States. *International Journal of Public Health*, *55*,167–75.

Jones, D. N., & Paulhus, D. L. (2010). Different provocations trigger aggression in narcissists and psychopaths. *Social and Personality*

Psychology Science, *1*, 12–18.

Jones, K. L., & Smith, D. W. (1973). Recognition of the fetal alcohol syndrome in early infancy. *Lancet*, *2*, 999–1001.

Jones, R. A. K., on behalf of the Collaborative Dexamethasone Trial Follow-up Group (2005). Randomized, controlled trial of dexamethasone in neonatal chronic lung disease: 13-to 17-year follow-up study: II. Respiratory status, growth, and blood pressure. *Pediatrics*, *116*, 379–384.

Jonides, J., Lacey, S., & Nee, D. (2005). Processes of working memory in mind and brain. *Current Directions in Psychological Science*, *14*, 2–5.

Jurcic, J., Pereira, J. A., & Kavanaugh, D. (2007). St. John's wort versus paroxetine for depression. *Canadian Family Physician*, *53*, 1511–1513.

Jordan, C. H., Wang, W., Donatoni, L. R., & Meier, B. P. (2014). Mindful eating: Trait and state mindfulness predict healthier eating behavior. *Personality and Individual Differences*, *68*, 107–111.

Josephson, W. L. (1987). Television violence and children's aggression: Testing the priming, social script, and disinhibition predictions. *Interpersonal Relations and Group Processes*, *53*, 882–890.

Jost, J. T., Glaser, J., Kruglanski, A. W., & Sulloway, F. J. (2003). Political conservativism as motivated social cognition. *Psychological Bulletin*,

129, 339–375.

Juda, M. N., Campbell, L., & Crawford, C. B. (2004). Dieting symptomatology in women and perceptions of social support: An evolutionary approach. *Evolution and Human Behavior*, *25*, 200–208.

Julius, D., & Basbaum, A. I. (2001). Molecular mechanisms of nociception. *Nature*, *413*, 203–210.

Jurcik, T. Ahmed, R., Yakobov, E., Solopieieva-Jurcikova, I., & Ryder, A. G. (2013). Understanding the role of the ethnic density effect: issues of acculturation, discrimination and social support. *Journal of Community Psychology*, *41*, 662–678.

Jusczyk, P. W., Friederici, A. D., Wessels, J., Svenkerud, V. Y., & Jusczyk, A. M. (1993). Infants' sensitivity to the sound patterns of native language words. *Journal of Memory and Language*, *32*, 402–420.

Kabat-Zinn, J. (1994). *Wherever you go, there you are: Mindfulness meditation in everyday life.* New York: Hyperion.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist*, *58*, 697–720.

Kahneman, D., & Miller, D. T. (1986). Norm theory: Comparing reality to its alternatives. *Psychological Review*, *93*, 136–153.

Kales, A., Soldatos, C. R., Bixler, E. O., Ladda, R. L., Charney, D. S., Weber, G., & Schweitzer, P. K. (1980). Hereditary factors in sleepwalking and night terrors. *The British Journal of Psychiatry*, *137*, 111–118.

Kalisch, R., Korenfeld, E., Stephan, K. E., Weiskopf, N., Seymour, B., & Dolan, R. J. (2006). Context-dependent human extinction memory is mediated by a ventromedial prefrontal and hippocampal network. *Journal of Neuroscience*, *26*, 9503–9511.

Kalnin, A. J., Edwards, C. R., Wang, Y., Kato, J., Ide, H., Kabashima, I., et al. (2009). Neural correlates of attitude change following positive and negative advertisements. *Frontiers in Behavioral Neuroscience*, *3*, 1–13.

Kam, J. W. Y., & Handy, T. C. (2014). Differential recruitment of executive resources during mind wandering. *Consciousness & Cognition*, *26*, 51–63.

Kamata, A., Tenenbaum, G., & Hanin, Y. L. (2002). Individual zones of optimal functioning (IZOF): A probabilistic estimation. *Journal of Sport & Exercise Psychology*, *24*, 189–208.

Kaminski, J., Call, J., & Fischer, J. (2004). Word learning in a domestic dog: Evidence for "fast mapping." *Science*, *304*, 1682–1683.

Kanayama, G., Rogowska, J., Pope, H. G., Gruber, S. A., & Yurgelun-Todd, D. A. (2004). Spatial working memory in heavy cannabis

users: A functional magnetic resonance imaging study. *Psychopharmacology*, *176*, 239–247.

Kanwisher, N., McDermott, J., & Chun, M. (1997). The fusiform face area: A module in human extrastriate cortex specialized for the perception of faces. *Journal of Neuroscience*, *17*, 4302–4311.

Kanwisher, N., Yovel, G. (2006). The fusiform face area: A cortical region specialized for the perception of faces. *Philosophical Transactions of the Royal Society of London B*., *361*, 2109–2128.

Kaplan, S. (2000). New ways to promote proenvironmental behavior: Human nature and environmentally responsible behavior. *Journal of Social Issues*, *56*, 491–508.

Kapler, I. V., Weston, T., & Wiseheart, M. (2015). Spacing in a simulated undergraduate classroom: Long-term benefits for factual and higher-level learning. *Learning & Instruction*, *36*, 38–45.

Karakashian, L. M., Walter, M. I., & Christopher, A. N. (2006). Fear of negative evaluation affects helping behavior: The bystander effect revisited. *North American Journal of Psychology*, *8*, 13–32.

Karau, S. J., & Williams, K. D. (2001). Understanding individual motivation in groups: The collective effort model. In M. E. Turner (Ed.), *Groups at work: Theory and research* (pp. 113–141). Mahwah, NJ: Lawrence Erlbaum Associates.

Kato, T. (2019). Current understanding of bipolar disorder: Toward integration of biological basis and treatment strategies. *Psychiatry and Clinical Neuroscience*. Epub ahead of print.

Kaufman, A. S. (2001). WAIS-III IQs, Horn's theory, and generational changes from young adulthood to old age. *Intelligence*, *29*, 131–167.

Kawai, M. (1965). Newly acquired pre-cultural behavior of a natural troop of Japanese monkeys on Koshima Island. *Primates*, *6*, 1–30.

Kawakami, K., Dovidio, J. F., Moll, J., Hermsen, S., & Russim, A. (2000). Just say no (to stereotyping): Effects of training in negation of stereotypic associations on stereotype activation. *Journal of Personality and Social Psychology*, *78*, 871–888.

Kay, A. C., Gaucher, D., McGregor, I., & Nash, K. (2010). Religious belief as compensatory control. *Personality and Social Psychology Review*, *14*, 37–48.

Kay, A. C., Whitson, J. A., Gaucher, D., & Galinsky, A. D. (2009). Compensatory control: Achieving order through the mind, our institutions, and the heavens. *Current Directions in Psychological Science*, *18*, 264–268.

Kaye, W. H., Gwirtsman, H. E., George, D. T., Weiss, S. R., & Jimerson, D. C. (1986). Relationship of mood alterations to bingeing behaviour in bulimia. *The British Journal of Psychiatry*, *149*, 479–485.

Kebbell, M., Milne, R., & Wagstaff, G. (1999). The cognitive interview: A survey of its forensic effectiveness. *Psychology, Crime, & Law*, *5*, 101–115.

Keel, P. K., & Klump, K. L. (2003). Are eating disorders culture-bound syndromes? Implications for conceptualizing their etiology. *Psychological Bulletin*, *129*, 747–769.

Kelemen, W. L., & Creeley, C. E. (2003). State-dependent memory effects using caffeine and placebo do not extend to metamemory. *Journal of General Psychology, 13D*, 70–86.

Kendrick, C., Sliwinski, J., Yu, Y., Johnson, A., Fisher, W., & Kekecs, Z. (2017). Hypnosis for acute procedural pain. *International Journal for Clinical and Experimental Hypnosis*, *64*, 75–115.

Kennard, M.A. (1942). Cortical reorganization of motor functions: Studies on a series of monkeys of various ages from infancy to maturity. *Archives of Neurology and Psychiatry*, *48*, 227–440.

Kennedy, A. M., Boyle, E. M., Traynor, T., Walsh, T., & Hill, A. D. K., (2011). Video gaming enhances psychomotor skills but not visuospatial and perceptual abilities in surgical trainees. *Journal of Surgical Education*, *68*, 414–420.

Kenny, D. A. (2004). PERSON: A general model of interpersonal perception. *Personality and Social Psychology Review*, *8*, 265–280.

Kensinger, E. A., & Corkin, S. (2003). Memory enhancement for emotional words: Are emotional words more vividly remembered than neutral words? *Memory & Cognition*, *31*, 1169–1180.

Kernis, M. H., Paradise, A. W., Whitaker, D. J., Wheatman, S. R., & Goldman, B. N. (2000). Master of one's psychological domain? Not likely if one's self-esteem is unstable. *Personality and Social Psychology Bulletin*, *26*, 1297–1305.

Kershaw, T. C., Hemmerich, J. A., & Ahmed, S. (2009). Flashbulb memory for September 11 and the Columbia space shuttle disaster. In M.R. Kelley, *Applied memory* (pp. 129–146). Hauppage, NY: Nova Science Publishers.

Kessler, R. C. (2000). Posttraumatic stress disorder: The burden to the individual and to society. *Journal of Clinical Psychiatry*, *61*(suppl. 5), 4–12.

Kessler, R. C., Chiu, W. T., Demler, O., & Walters, E. E. (2005). Prevalence, severity, and comorbidity of twelve-month DSM-IV disorders in the National Comorbidity Survey Replication (NCS-R). *Archives of General Psychiatry*, *62*, 617–627.

Kevles, D. J. (1985). *In the name of eugenics: Genetics and the uses of human heredity*. New York? Alfred A. Knopf, Inc.

Kiecolt-Glaser, J. (1984). Psychosocial modifiers of immunocompetence in medical students. *Psychosomatic Medicine*, *46*, 7–14.

Kiecolt-Glaser, J. K., & Newton, T. L. (2001). Marriage and health: His and hers. *Psychological Bulletin*, *127*, 472–503.

Kigar, D. L., Witelson, S. F., Glezer, I. I., & Harvey, T. (1997). Estimates of cell number in temporal neocortex in the brain of Albert Einstein. *Social Neurosciences Abstracts*, *23*, 88–89.

Kihlstrom, J. F. (1997). Hypnosis, memory and amnesia. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *352*, 1727–1732.

Kihlstrom, J. F. (2005). Dissociative disorders. *Annual Review of Clinical Psychology*, *1*, 227–253.

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, *330*, 932.

Kilpatrick, L., & Cahill, L. (2003). Amygdala modulation of parahippocampal and frontal regions during emotionally influenced memory storage. *NeuroImage*, *20*, 2091–2099.

Kim, M. K., Lee, S. M., Bae, S-H., Kim, H. J., Lim, N. G., Yoon, S-J., Lee, J. Y., & Jo, M-W. (2018). Socioeconomic status can affect pregnancy outcomes and complications, even with a universal healthcare system. *International Journal of Equity in Health*, *17*, 2.

Kim, P., Leckman, J. F., Mayes, L. C., Feldman, R., Xin, W., & Swain, J. E. (2010). The plasticity of human maternal brain: Longitudinal

changes in brain anatomy during the early postpartum period. *Behavioral Neuroscience*, *124*, 695–700.

King, D. B., & DeCicco, T. L. (2007). The relationships between dream content and physical health, mood, and self-construal. *Dreaming*, *17*, 127–139.

King, S. (2000). Is expressed emotion cause or effect in the mothers of schizophrenic young adults? *Schizophrenia Research*, *45*, 65–78.

King, S., & Dixon, M. J. (1999). Expressed emotion and relapse in young schizophrenia outpatients. *Schizophrenia Bulletin*, *25*, 377–386.

King, S., St. Hilaire, A., & Heidkamp, D. (2010). Prenatal factors in schizophrenia. *Current Directions in Psychological Science*, *19*, 209–213.

Kingston, T., Dooley, B., Bates, A., Lawlor, E., & Malone, K. (2007). Mindfulness-based cognitive therapy for residual depressive symptoms. *Psychology and Psychotherapy: Theory, Research and Practice*, *80*, 193–203.

Kinsey, A. C., Pomeroy, W. B., & Martin, C. E. (1948). *Sexual behaviour in the human male*. Philadelphia: W.B. Saunders.

Kinsey, A. C., Pomeroy, W. B., & Matin, C. E. (1953). *Sexual behaviour in the human female*. Philadelphia: W.B. Saunders.

Kirk, K. M., Bailey, J. M., Dunne, M. P., & Martin, N. G. (2000). Measurement models for sexual orientation in a community twin sample. *Behavioral Genetics*, *30*, 345–356.

Kirkham, T. C. (2009). Cannabinoids and appetite: Food craving and food pleasure. *International Review of Psychiatry*, *21*, 163–171.

Kirmayer, L. J., & Ryder, A. G. (2016). Culture and psychopathology. *Current Opinion in Psychology*, *8*, 143–148.

Kirmayer, L. J., Guzder, J., & Rousseau, C. (2014). *Cultural consultation: Encountering the other in mental health care*. New York: Springer.

Kirsch, I., & Lynn, S. (1998). Dissociation theories of hypnosis. *Psychological Bulletin*, *123*, 100–115.

Kirschbaum, C., Pirke, K. M., & Hellhammer, D. K. (1993). The "Trier Social Stress Test"—A tool for investigating psychobiological stress in a laboratory setting. *Neuropsychobiology*, *28*, 76–81.

Kirschbaum, C., Wust, S., & Hellhammer, D. (1992). Consistent sex differences in cortisol responses to psychological stress. *Psychosomatic Medicine*, *54*, 648–657.

Kisely, S. R., Campbell, L. A., & Preston, N. J. (2011). Compulsory community and involuntary outpatient treatment for people with severe mental disorders. *Cochrane Database of Systematic Reviews*, *2*.

Kisilevsky, B. S., Hains, S. M., Lee, K., Xie, X., Huang, H., Ye, H. H., et al. (2003). Effects of experience on fetal voice recognition. *Psychological Science*, *14*, 220–224.

Klatzky, R. L., & Creswell, J. D. (2014). An intersensory interaction account of priming effects—and their absence. *Perspectives on Psychological Science*, *9*, 49–58.

Klaus, L., Berner, M. M., & Levente, K. (2008). St. John's wort for major depression. In *Cochrane Database of Systematic Reviews: Reviews 2008*, 4. Chichester, UK: John Wiley & Sons.

Kleider, H., Pezdek, K., Goldinger, S., & Kirk, A. (2008). Schema-driven source misattribution errors: Remembering the expected from a witnessed event. *Applied Cognitive Psychology*, *22*, 1–20.

Klein, N. (2007). *The shock doctrine: The rise of disaster capitalism*. New York: Picador.

Klein, R. A., Ratliff, K. A., Vianello, M., Abrams, Jr., R. B., Bahnîk, S., ... Nosek, B. A. (2014). Investigating variation in replicability: A "many labs" replication project. *Social Psychology*, *45*, 142–152.

Klerman, G. L., & Weissman, M. M. (1993). *New applications of interpersonal psychotherapy*. Washington DC: American Psychiatric Press.

Klerman, G. L., Weissman, M. M., Rounsaville, B. J., et al. (1984). *Interpersonal psychotherapy of depression*. Northvale, NJ: Jason Aronson Inc.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., ... Westerberg, H. (2005). Computerized training of working memory in children with ADHD—a randomized, controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, *44*, 177–186.

Klomek, A., Marrocco, F., Kleinman, M., Schonfeld, I., & Gould, M. (2007). Bullying, depression, and suicidality in adolescents. *Journal of the American Academy of Child & Adolescent Psychiatry*, *46*, 40–49.

Kluger, B. M., & Triggs, W. J. (2007). Use of transcranial magnetic stimulation to influence behavior. *Current Neurology and Neuroscience Reports*, *6*, 491–497.

Knaepen, K. Goekint, M., Heyman, E. M., & Meeusen, R. (2010). Neuroplasticity —exercise-induced response of peripheral brain-derived neurotrophic factor: A systematic review of experimental studies in human subjects. *Sports Medicine*, *40*, 765–801.

Knutson, B., Fong, G. W., Bennett, S. M., Adams, C. M., & Hommer, D. (2003). A region of mesial prefrontal cortex tracks monetarily rewarding outcomes: Characterization with rapid event-related fMRI. *NeuroImage*, *18*, 263–272.

Koball, H. L., Moiduddin, E., Henderson, J., Goesling, B., & Besculides, M. (2010). What do we know about the link between marriage and

health? *Journal of Family Issues*, *31*, 1019–1040.

Kobayashi, Y., Takemoto, R., Yamato, S., Okada, T., Iijima, M., Uematsu, Y., ... Saito, Y. (2018). Depression-resistant phenotype in mice overexpressing regulator of G protein signaling 8 (RGS8). *Neuroscience*, *383*, 160–169.

Koch, C., Massimini, M., Boly, M., & Tononi, G. (2016). Neural correlates of consciousness: Progress and problems. *Nature Reviews Neuroscience*, *17*, 307–321.

Kohlberg, I. (1984). *The psychology of moral development: Essays on moral development* (Vol. II). San Francisco: Harper & Row.

Kokkoris, M. D. (2016). Revisiting the relationship between maximizing and well-being: An investigation of eudaimonic well-being. *Personality and Individual Differences*, *99*, 174–178.

Kolb, B. (1989). Brain development, plasticity, and behavior. *American Psychologist*, *44*, 1203–1212.

Kolb, B. (1995). *Brain plasticity and behavior*. Florence, KT: Routledge.

Kolb, B., Teskey, G. C., & Gibb, R. (2010). Factors influencing cerebral plasticity in the normal and injured brain. *Frontiers in Human Neuroscience*, *4*, 1–12.

Koletić, G. (2017). Longitudinal associations between the use of sexually explicit material and adolescents' attitudes and behaviors: A narrative review of studies. *Journal of Adolescence*, *57*, 119–133.

Komisaruk, B. R. (2005). Functional MRI of the brain during orgasm in women. *Annual Review of Sex Research*, *16*, 62–86.

Koob, G. F. (1992). Neural mechanisms of drug reinforcement. *Annals of the New York Academy of Sciences*, *654*, 171–191.

Koob, G. F., & Volkow, N. D. (2010). Neurocircuitry of addiction. *Neuropsychopharmacology*, *35*, 217–238.

Kornell, N. (2009). Optimising learning using flashcards: Spacing is more effective than cramming. *Applied Cognitive Psychology*, *23*, 1297–1317.

Kornell, N., & Bjork, R. A. (2007). The promise and perils of self-regulated study. *Psychonomic Bulletin & Review*, *14*, 219–224.

Kornelsen, J., Smith, S.D., McIver, T.A., Sboto-Frankenstein, U., Latta, P., & Tomanek, B. (2013). Functional MRI of the thoracic spinal cord during vibration sensation. *Journal of Magnetic Resonance Imaging*, *37*, 981–985.

Kornhaber, M. (2004). Multiple intelligences: From the ivory tower to the dusty classroom—but why? *Teachers College Record*, *106*, 67–76.

Kotchoubey, B., Kaiser, J., Bostanov, V., Lutzenberger, W., & Birbaumer, N. (2009). Recognition of affective prosody in brain-damaged patients and healthy controls: A neurophysiological study using EEG and whole-head MEG. *Cognitive, Affective, & Behavioral Neuroscience*, *9*, 153–167.

Kouprina, N., Pavlicek, A., Mochida, G. H., Solomon, G., Gersch, W., Yoon, Y. H., et al. (2002). Accelerated evolution of the ASPM gene controlling brain size begins prior to human brain expansion. *PloS Biology*, *2*, 0653–0663.

Kovacs, A. M., & Mehler, J. (2009). Cognitive gains in 7-month-old bilingual infants. *Current Issue*, *106*, 6556–6560.

Kowal, M. A., Hazekamp, A., Colzato, L. S., van Steenbergen, H., van der Wee, N. J., ... Hommel, B. (2015). Cannabis and creativity: Highly potent cannabis impairs divergent thinking in regular cannabis users. *Psychopharmacology*, *232*, 1123–1134.

Kowalczyk, N., Shi, F., Magnuski, M., Skorko, M., Dobrowolski, P., Kossowski, B., ... Brzezicka, A. (2018). Real-time strategy video game experience and structural connectivity – A diffusion tensor imaging study. *Human Brain Mapping*, *39*, 3742–3758.

Kramer, A F., Hahn, S., Cohen, N. J., Banich, M. T., McAuley, E., Harrison, C. R., et al. (1999). Ageing, fitness and neurocognitive function. *Nature*, *400*, 418–419.

Kramer, A. D. I., Guillory, J. E., & Hancock, J. T. (2014). Experimental evidence of massive-scale emotional contagion through social networks. *PNAS Proceedings of the National Academy of Sciences of the United States of America*, *111*, 8788–8790.

Kramer, M., Schoen, L. S., & Kinney, L. (1984). Psychological and behavioral features of disturbed dreamers. *Psychiatric Journal of the University of Ottawa*, *9*, 102–106.

Kramer, R. M. (1998). Paranoid cognition in social systems. Thinking and acting in the shadow of doubt. *Personality and Social Psychology Review*, *2*, 251–75.

Kramer, T. H., Buckhout, R., & Eugenio, P. (1990). Weapon focus, arousal, and eyewitness memory. *Law and Human Behavior*, *14*, 167–184.

Kraus, C., Castrén, E., Kasper, S., & Lanzenberger, R. (2017). Serotonin and neuroplasticity – Links between molecular, functional and structural pathophysiology in depression. *Neuroscience and Biobehavioral Reviews*, *77*, 317–326.

Kreukels, B. P. C., & Guillamon, A. (2016). Neuroimaging studies in people with gender incongruence. *International Review of Psychiatry*, *28*, 120–128.

Krevans, J., & Gibbs, J. C. (1996). Parents' use of inductive discipline: Relations to children's empathy and prosocial behavior. *Child Development*, *67*, 3263–3277.

Kringelbach, M. L., Jenkinson, N., Owen, S. L. F., & Aziz, T. Z. (2007). Translational principles of deep brain stimulation. *Nature Reviews Neuroscience*, *8*, 623–635.

Kristensen, P., & Bjerkedal, T. (2007). Explaining the relation between birth order and intelligence. *Science*, *316*, 1717–1718.

Krolak-Salmon, P., Hénaff, M.-A., Vighetto, A., Bertrand, O., & Mauguière, F. (2004). Early amygdala reaction to fear spreading in occipital, temporal, and frontal cortex: A depth electrode ERP study in human. *Neuron*, *42*, 665–676.

Kroska, A., & Harkness, S. K. (2006). Stigma sentiments and self-meanings: Exploring the modified labeling theory of mental illness. *Social Psychology Quarterly*, *69*, 325–348.

Kruger, J., Wirtz, D., & Miller, D. (2005). Counterfactual thinking and the first instinct fallacy. *Journal of Personality and Social Psychology*, *88*, 725–735.

Krystal, A. (2009). A compendium of placebo-controlled trials of the risks/benefits of pharmacological treatments for insomnia: The empirical basis for U.S. clinical practice. *Sleep Medicine Reviews*, *13*, 265–274.

Kubzansky, L. D., Sparrow, D., Vokonas, P., & Kawachi, I. (2001). Is the glass half empty or half full? A prospective study of optimism and

coronary heart disease in the normative aging study. *Psychosomatic Medicine*, *63*, 910–916.

Kudielka, B. M., & Kirschbaum, C. (2005). Sex differences in HPA axis responses to stress: A review. *Biological Psychology*, *69*, 113–132.

Kühn, S., & Gallinat, J. (2014). Brain structure and functional connectivity associated with pornography consumption: the brain on porn. *Journal of the American Medical Association: Psychiatry*, *71*, 827–834.

Kuncel, N. R., & Hezlett, S. A. (2010). Fact and fiction in cognitive ability testing for admissions and hiring decisions. *Current Directions in Psychological Science*, *19*, 339–345.

Kurdek, L. A. (2005). Gender and marital satisfaction early in marriage: A growth curve approach. *Journal of Marriage and Family*, *67*, 68–84.

Kurjak, A., Pooh, R. K., Merce, L. T., Carrera, J. M., Salihagic-Kadic, A., & Andonotopo, W. (2005). Structural and functional early human development assessed by three-dimensional and four-dimensional sonography. *Fertility and Sterility*, *84*, 1285–1299.

Kwong, K. K., Belliveau, J. W., Chesler, D. A., Goldberg, I. E., Weisskoff, R. M., Poncelet, B. P., et al. (1992). Dynamic magnetic resonance imaging of human brain activity during primary sensory stimulation. *Proceedings of the National Academy of Sciences of the United States of America*, *89*, 5675–5679.

La Guardia, J. G. (2009). Developing who I am: A self-determination theory approach to the establishment of healthy identities. *Educational Psychologist*, *44*, 90–104.

LaBar, K. S., & Cabeza, R. (2006). Cognitive neuroscience of emotional memory. *Nature Neuroscience*, *7*, 54–64.

LaBar, K. S., & Phelps, E. A. (1998). Arousal-mediated memory consolidation: Role of the medial temporal lobe in humans. *Psychological Science*, *9*, 490–493.

Labin, A.M, & Riback, E.N. (2010). Retinal glial cells enhance human vision acuity. *Physical Review Letters*, *104*, 158102.

LaBrie, J. W., Lewis, M. A., Atkins, D. C., Neighbors, C., Zheng, C., Kenney, S. R., ... Larimer, M. E. (2013). RCT of web-based personalized normative feedback for college drinking prevention: Are typical student norms good enough? *Journal of Consulting and Clinical Psychology*, *81*, 1074–1086.

Labrie, V., Pai, S., & Petronis, A. (2012). Epigenetics of major psychosis: Progress, problems, and perspectives. *Trends in Genetics*, *28*, 427–435.

Lafaye, G., Desterke, C., Marulaz, L., & Benyamina, A. (2018). Cannabidiol affects circadian clock core complex and its regulation in microglia cells. *Addiction Biology*, *24*, 921–934.

Lafer-Sousa, R., Hermann, K. L., & Conway, B. R. (2015). Striking individual differences in color perception uncovered by “the dress” photograph. *Current Biology*, *25*, R545–R546.

Laier, C., Pekal, J., & Brand, M. (2014). Cybersex addiction in heterosexual female users of internet pornography can be explained by gratification hypothesis. *Cyberpsychology, Behavior, and Social Networks*, *17*, 505–511.

Laier, C., Pekal, J., & Brand, M. (2015). Sexual excitability and dysfunctional coping determines cybersex addiction in homosexual males. *Cyberpsychology, Behavior, and Social Networks*, *18*, 575–580.

Lakin, J. L., & Chartrand, T. L. (2003). Using nonconscious behavioral mimicry to create affiliation and rapport. *Psychological Science*, *14*, 334–339.

Lakin, J. L., Jefferis, V. E., Cheng, C. M., & Chartrand, T. L. (2003). The chameleon effect as social glue: Evidence for the evolutionary significance of nonconscious mimicry. *Journal of Nonverbal Behavior*, *27*, 145–162.

Lam, D. H. (1991). Psychosocial family intervention in schizophrenia: A review of empirical studies. *Psychological Medicine*, *21*, 423–441.

Laming, D. (2010). Serial position curves in free recall. *Psychological Review*, *117*, 93–133.

Lampe & Malhi (2018). Avoidant personality disorder: current insights. *Psychology Research and Behavior Management*, *11*, 55–66.

Landau, M. J., Kay, A .C., & Whitson, J. (2015). Compensatory control and the appeal of a structured world. *Psychological Bulletin*. *141*, 694–722.

Landau, M. J., Solomon, S., Greenberg, J., Cohen, J., Pyszczynski, T., ... Cook, A. (2004). Deliver us from evil: The effects of mortality salience and reminders of 9/11 on support for President George W. Bush. *Personality and Social Psychology Bulletin*, *30*, 1136–1150.

Landrigan, C. P., Rothschild, J. M., Cronin, J. W., Kaushal, R., Burdick, E., Katz, J. T., et al. (2004). Effect of reducing interns' work hours on serious medical errors in intensive care units. *New England Journal of Medicine*, *351*, 1838–1848.

Landry, M., & Raz, A. (2015). Hypnosis and imaging of the living human brain. *American Journal of Clinical Hypnosis*, *57*, 285–313.

Laneri, D., Schuster, V., Dietsche, B., Jansen, A., Ott, U., & Sommer, J. (2016). Effects of long-term mindfulness meditation on brain's white matter microstructure and its aging. *Frontiers in Aging Neuroscience*, *7*, article 254.

Laney, C., Heuer, F., & Reisberg, D. (2003). Thematically-induced arousal in naturally-occurring emotional memories. *Applied Cognitive Psychology*, *17*, 995–1004.

Langford, D. J., Crager, S. E., Shehzad, Z., Smith, S. B., Sotocinal, S. G., ... Mogil, J.S. (2006). Social modulation of pain as evidence for empathy in mice. *Science*, *312*, 1967–1970.

Langford, D. J., Tuttle, A. H., Briscoe, C., Harvey-Lewis, C., Baran, I., Gleeson, P., et al. (2011). Varying perceived social threat modulates pain behavior in male mice. *The Journal of Pain*, *12*, 125–132.

Langhans, W. (1996a). Metabolic and glucostatic control of feeding. *Proceedings of the Nutritional Society*, *55*, 497–515.

Langhans, W. (1996b). Role of the liver in the metabolic control of eating: What we know—and what we do not know. *Neuroscience and Biobehavioral Review*, *20*, 145–153.

Langston, J. W., Ballard, P., Tetrud, J. W., & Irwin, I. (1983). Chronic Parkinsonism in humans due to a product of meperidine-analog synthesis. *Science*, *219*, 979–980.

Långström, N., Rahman, Q., & Carlstrom, E. (2010). Genetic and environmental effects on same-sex sexual behavior: A population study of twins in Sweden. *Archives of Sexual Behavior*, *39*, 75–80.

Large, E. W., & Palmer, C. (2002). Perceiving temporal regularity in music. *Cognitive Science*, *26*, 1–37.

Larsen, R. J., Kasimatis, M., & Frey, K. (1992). Facilitating the furrowed brow: An unobtrusive test of the facial feedback hypothesis applied

to unpleasant affect. *Cognition & Emotion*, *6*, 321–338.

Lasco, M. S., Jordan, T. J., Edgar, M. A., Petito, C. K., & Byne, W. (2002). A lack of dimorphism of sex or sexual orientation in the human anterior commissure. *Brain Research*, *936*, 95–98.

Latané B., Williams, K., & Harkins, S. (2006). Many hands make the light work: The causes and consequences of social loafing. In J. M. Levine & R. L. Moreland (Eds.), *Small groups* (pp. 297–308). New York: Psychology Press.

Latané, B., & Darley, J. M. (1968). Group inhibition of bystander intervention in emergencies. *Journal of Personality and Social Psychology*, *10*, 215–221.

Lattal, K. A. (2010). Delayed reinforcement of operant behaviour. *Journal of the Experimental Analysis of Behavior*, *93*, 129–139.

Laureys, S., Owen, A. M., & Schiff, N. D. (2004). Brain function in coma, vegetative state, and related disorders. *Lancet Neurology*, *3*, 537–546.

Lautenschlager, N. T., Cox, K. L., Flicker, L., Foster, J. K., van Bockxmeer, F. M., Xiao, J., et al. (2008). Effect of physical activity on cognitive function in older adults at risk for Alzheimer disease. *The Journal of the American Medical Association*, *300*, 1027–1037.

Lay, C. H., & Safdar, A. F. (2003). Daily hassles and distress among college students in relation to immigrant and minority status. *Current Psychology*, *22*, 3–22.

Lavie, P. (2001). Sleep–wake as a biological rhythm. *Annual Review of Psychology*, *5*, 277–303.

Lazar, S. W., Kerr, C. E., Wasserman, R. H., Gray, J. R., Greve, D. N., Treadway, M. T., et al. (2005). Meditation experience is associated with increased cortical thickness. *Neuroreport 16*, 1893–1897.

Lazarus, R. S., & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer Publishing Company.

Leary, M. R., Kowalski, R. M., Smith, L., & Phillips, S. (2003). Teasing, rejection, and violence: Case studies of the school shootings. *Aggressive Behavior*, *29*, 202–214.

Lebens, H., Roefs, A., Martijn, C., Houben, K., Nederkoorn, C., & Jansen, A. (2011). Making implicit measures of associations with snack foods more negative through evaluative conditioning. *Eating Behaviors*, *12*, 249–253.

Leblanc, V. R., Norman, G. R., & Brooks, L. R. (2001). Effect of a diagnostic suggestion on diagnostic accuracy and identification of clinical features. *Academic Medicine*, *76*, S18–S20.

Leboe, J. P., & Whittlesea, B. W. A. (2002). The inferential basis of familiarity and recall. *The Journal of Memory and Language*, *46*, 804–829.

Lederman, S. J., & Klatzky, R. L. (2004). Haptic identification of common objects: Effects of constraining the manual exploration process. *Perception and Psychophysics*, *66*, 618–628.

Lederman, S. J., Kilgour, A., Kitada, R., Klatzky, R. I., & Hamilton, C. (2007). Haptic face processing. *Canadian Journal of Experimental Psychology*, *61*, 230–241.

LeDoux, J. E. (2000). Emotion circuits in the brain. *Annual Review of Neuroscience*, *23*, 155–184.

Lee, G., Byram, A. C., Owen, A. M., Ribary, U., Stoessl, A. J. ... Illes, J. (2015). Canadian perspectives on the clinical actionability of neuroimaging in disorders of consciousness. *Canadian Journal of Neurological Sciences*, *42*, 96–105.

Lee, H., Xie, L., Yu, M., Kang, H., Feng, T., ... Benveniste, H. (2015). The effect of body posture on brain glymphatic transport. *Journal of Neuroscience*, *35*, 11034–11044.

Lee, H. J., Macbeth, A. H., Pagani, J. H., & Young, W. S. (2009). Oxytocin: The great facilitator of life. *Progress in Neurobiology*, *88*, 127–151.

Lee, H. J., Ryu, J-S., Choi, N. Y., Park, Y. S., Kim, Y. I., ...Ko, K. (2013). Transgenerational effects of paternal alcohol exposure in mouse offspring. *Animal Cells and Systems*, *17*(6), 429–434,

Lee, J. L. C. (2010). Memory reconsolidation mediates the updating of hippocampal memory content. *Frontiers in Behavioural Neuroscience*, *11*, 168.

Lee, K., & Ono, H. (2012). Marriage, cohabitation, and happiness: A cross-national analysis of 27 countries. *Journal of Marriage and Family*, *74*, 953–972.

Lee, R. (2017). Mistrustful and misunderstood: A review of paranoid personality disorder. *Current Behavior and Neuroscience Reports*, *4*, 151–165.

Lefkowitz, E. S. (2005). "Things have gotten better": Developmental changes among emerging adults after the transition to university. *Journal of Adolescent Research*, *20*, 40–63.

Lefkowitz, M., Blake, R. R., & Mouton, J. S. (1955). Status factors in pedestrian violation of traffic signals. *Journal of Abnormal and Social Psychology*, *51*, 704–706.

Lehmann, J., Nuevo-Chiquero, A., & Vidal-Fernandez, M. (2018).The early origins of birth order differences in children's outcomes and parental behavior. *Journal of Human Resources*, *53*(1), 123–156.

Leichtman, M. D., & Ceci, S. J. (1995). The effects of stereotypes and suggestions on preschoolers' reports. *Developmental Psychology*, *31*, 568–578.

Leighton, J. P., & Sternberg, R. J. (2003). Reasoning and problem solving. In A. F. Healy & R. W. Proctor (Eds.), *Handbook of psychology: Experimental psychology* (Vol. 4, pp. 623–648). Hoboken, NJ: John Wiley & Sons.

Leiserowitz, A., Maibach, E., Roser-Renouf, C., & Smith, N. (2010). *Climate change in the American mind: Americans' global warming beliefs and attitudes in January 2010*. Yale University and George Mason University. New Haven, CT: Yale Project on Climate Change Communication.

Lejuez, C. W., Magidson, J. F., Mitchell, S. H., Sinha, R., Stevens, M. C., & de Wit, H. (2010). Behavioral and biological indicators of impulsivity in the development of alcohol use, problems, and disorders. *Alcoholism: Clinical and Experimental Research*, *34*, 1334–1345.

Lenroot, R. K., & Giedd, J. N. (2007). The structural development of the human brain as measured longitudinally with magnetic resonance imaging. In Coch, D., Fischer, K. W., & Dawson, G. (Eds.), *Human behavior, learning, and the developing brain: Typical development* (pp. 50–73). New York: Guilford Press.

Lepper, M. P., Greene, D., & Nisbett, R. E. (1973). Undermining children's intrinsic interest with extrinsic reward: A test of the

“overjustification” hypothesis. *Journal of Personality and Social Psychology*, *28*, 129–137.

Lesage, A., Vasiliadis, H.-M., Gagné, M.-A., Dudgeon, S., Kasman, N., & Hay, C. (2006). *Prevalence of mental illness and related service utilization in Canada: An analysis of the Canadian Community Health Survey*. Mississauga, ON: Canadian Collaborative Mental Health Initiative.

Lesch, K-P., Bengel, D., Heils, A., et al. (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science*, *273*, 1527–1531.

Lett, H. S., Blumenthal, J. A., Babyak, M. A., Sherwood, A., Strauman, T., ... Newman, M.F. (2004). Depression as a risk factor for coronary artery disease: Evidence, mechanisms, and treatment. *Psychosomatic Medicine*, *66*, 303–315.

Leucht, S., Arbter, D., Engel, R., Dienel, A., & Kieser, M. (2009). How effective are second-generation antipsychotic drugs? A meta-analysis of placebo-controlled trials. *Molecular Psychiatry*, *14*, 429–447.

LeVay, S. (1991). A difference in hypothalamic structure between heterosexual and homosexual men. *Science*, *253*, 1034–1037.

Levenson, M., & Guerra, C. (2017, October 16). Sexual harassment allegations lead millions of women to say #Metoo. *The Boston Globe*. Retrieved from www.bostonglobe.com/metro/2017/10/16/

Levenston, G. K., Patrick, C. J., Bradley, M. M., & Lang, P. J. (2000). The psychopath as observer: Emotion and attention in picture processing. *Journal of Abnormal Psychology*, *109*, 373–385.

Levin, R. (1994). Sleep and dreaming characteristics of frequent nightmare subjects in a university population. *Dreaming*, *4*, 127–137.

Levin, R., & Fireman, G. (2002). Nightmare prevalence, nightmare distress, and self-reported psychological disturbance. *Sleep*, *25*, 205–212.

Levin, R., & Nielson, T. A. (2007). Disturbed sleeping, posttraumatic disorder, and affect distress: A review and neurocognitive model. *Psychological Bulletin*, *133*, 482–528.

Levine, Alexandra, J. (2018, July 30). New York today: The city's bystander effect. *New York Times*. Retrieved from www.nytimes.com

Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. (2002). Aging and autobiographical memory: Dissociating episodic from semantic retrieval. *Psychology and Aging*, *17*, 677–689.

Levine, G. N., Lange, R. A., Bairey-Merz, C. N., Davidson, R. J., Jamerson, K., Mehta, ... American Heart Association Council on Clinical Cardiology; Council on Cardiovascular and Stroke Nursing; and Council on Hypertension (2017). Meditation and cardiovascular risk reduction: A scientific statement from the American Heart

Association. *Journal of the American Heart Association*, *6*(10), e002218.

Levine, L. J., & Pizarro, D. A. (2004). Emotion and memory research: A grumpy overview. *Social Cognition*, *22*, 530–554.

Levine, M. P., Smolak, L., & Hayden, H. (1994). The relation of sociocultural factors to eating attitudes and behaviors among middle school girls. *The Journal of Early Adolescence*, *14*, 471–490.

Levine, M., & Crowther, S. (2008). The responsive bystander: How social group membership and group size can encourage as well as inhibit bystander intervention. *Journal of Personality and Social Psychology*, *95*(6), 1429–1439. https://proxy.augustana.edu:2138/10.1037/a0012634

Levinson, B. W. (1965). States of awareness during general anaesthesia. *British Journal of Anaethesia*, *37*, 544–546.

Levitin, D. (2006). *This is your brain on music: The science of a human obsession*. New York: Dutton Books.

Levy, S. (2015, April 17). Yes, I found Einstein's brain. *Wired*. Retrieved from www.wired.com/2015/04/yes-i-found-einsteins-brain/

Lewin, K. (1936). *Principles of topological psychology*. New York: McGraw-Hill.

Lewin, T. (2009, October 23). No Einstein in your crib? Get a refund. *The New York Times*.

Lewis-Fernández, R., Aggarwal, N. K., Bäärnhielm, S., Kirmayer, L. J., Weiss, M. G., ... Lu, F. (2014). Culture and psychiatric evaluation : Operationalizing cultural formulation for DSM-5 culture and psychiatric evaluation. *Psychiatry*, *77*, 130–154.

Li, C. (2015). Primacy Effect or Recency Effect? A Long-Term Memory Test of the 2006 Super Bowl Commercials. In: Sharma D., Borna S. (Eds.), *Proceedings of the 2007 Academy of Marketing Science (AMS) Annual conference. Developments in marketing science*: Proceedings of the Academy of Marketing Science. Springer, Cham.

Li, L., & Yong, H. H. (2009). Tobacco advertising on the street in Kunming, China. *Tobacco Control*, *18*, 63.

Li, T., Wang, P., Wang, S. C. & Wang, Y-F. (2017) Approaches mediating oxytocin regulation of the immune system. *Frontiers in Immunology*, *7*, 693.

Lieberman, L. (2001). How "Caucasoids" got such big crania and why they shrank: From Morton to Rushton. *Current Anthropology*, *42*, 69–95.

Lieberman, P. (1984). *The biology and evolution of language*. Cambridge, MA: Harvard University Press.

Liebowitz, M. R. (1983). *The chemistry of love*. Boston: Little, Brown, & Co.

Liégeois, F., Badeweg, T., Connelly, A., Gadian, D. G., Mishkin, M., & Vargha-Khadem, F. (2003). Language fMRI abnormalities associated with FOXP2 gene mutation. *Nature Neuroscience*, *6*, 1230–1237.

Light, K. C., Grewen, K. M., & Amico, J. A. (2005). More frequent partner hugs and higher oxytocin levels are linked to lower blood pressure and heart rate for women in premenopausal women. *Biological Psychology*, *69*, 5–21.

Light, K. C., Smith, T. E., Johns, J. M., Brownley, K. A., Hofheimer, J. A., & Amico, J. A. (2000). Oxytocin responsivity in mothers of infants: A preliminary study of relationship with BP during laboratory stress and normal ambulatory activity. *Health Psychology*, *19*, 560–567.

Lilienfeld, S. (2007). Psychological treatments that cause harm. *Perspectives on Psychological Science*, *2*, 53–70.

Lilienfeld, S. O., & Arkowitz, H. (2009, February). Lunacy and the full moon. *Scientific American*, *20*, 64–65.

Lilienfeld, S. O., & Lynn, S. J. (2003). Dissociative identity disorder: Multiple personality, multiple controversies. In S. O. Lilienfeld, J. M. Lohr, & S. J. Lynn (Eds.), *Science and pseudoscience in clinical psychology* (pp. 109–142). New York: Guilford Press.

Lilienfeld, S. O., Lynn, S. J., Kirsch, I., Chaves, J. F., Sarbin, T. R., ... Powell, R. A. (1999). Dissociative identity disorder and the sociocognitive model: Recalling the lessons of the past. *Psychological Bulletin*, *125*, 507–523.

Lilienfeld, S. O., Wood, J. M., & Garb, H. N. (2000). The scientific status of projective techniques. *Psychological Science in the Public Interest*, *1*, 27–66.

Lillard, A. (1998). Ethnopsychologies: Cultural variations in theories of mind. *Psychological Bulletin*, *123*, 3–32.

Lima, I. M. M., Peckham, A. D., & Johnson, S. L. (2018). Cognitive deficits in bipolar disorders: Implications for emotion. *Clinical Psychology Review*, *59*, 126–136.

Lin, C., Davidson, T., & Ancoli-Israel, S. (2008). Gender differences in obstructive sleep apnea and treatment implications. *Sleep Medicine Reviews*, *12*, 481–496.

Lindau, S. T., Schumm, L. P., Laumann, E. O., Levinson, W., O'Muircheartaigh, C. A., & Waite, L. J. (2007). A study of sexuality and health among older adults in the United States. *New England Journal of Medicine*, *357*, 762–774.

Linde, K., Berner, M. M., & Kriston, L. S. (2008). St. John's wort for major depression. *Cochrane Database of Systemic Reviews*, *4*, CD000448.

Lindsay, R. C. L., Semmler, C., Weber, N., Brewer, N. & Lindsay, M. R. (2008). How variations in distance affect eyewitness reports and identification accuracy. *Law & Human Behavior*, *32*, 526–535.

Linehan, M. (1993). *Cognitive behavioral treatment of borderline personality disorder*. New York: Guilford Press.

Link, B. G. (1987). Understanding labeling effects in the area of mental disorders: An assessment of the effects of expectations of rejection. *American Sociological Review*, *52*, 96–112.

Link, B. G., Cullen, F. T., Struening, E., Shrout, P. E., & Dohrenwend, B. P. (1989). A modified labeling theory approach to mental disorders: An empirical assessment. *American Sociological Review*, *54*, 400–423.

Liu, J., Li, J., Li, L., Tian, J., & Lee, K. (2014). See Jesus in toast: Neural and behavioral correlates of face pareidolia. *Cortex*, *53*, 60–77.

Liu, O. L., Bridgeman, B., Gu, L., Xu, J., & Kong, N. (2015). Investigation of response changes in the GRE revised general test. *Educational and Psychological Measurement*, *75*, 1002–1020.

Liu, X., Lauer, K. K., Ward, B. D., Roa, S. M., Li, S. J., & Hudetz, A. G. (2012). Propofol disrupts functional interactions between sensory and high-order processing of auditory verbal memory. *Human Brain Mapping*, *33*, 2487–2498.

Liu, Y., Shen, X., Zhu, Y., Xu, Y., Cai, W., ... Wang, W. (2007). Mismatch negativity in paranoid, schizotypal, and antisocial personality disorders. *Clinical Neurophysiology*, *37*, 89–96

Liu, Y., Zhao, J., & Guo, W. (2018). Emotional roles of mono-aminergic neurotransmitters in major depressive disorder and anxiety disorders. *Frontiers in Psychology*, *9*, article 2201.

Livingstone, M. S., & Conway, B. R. (2004). Was Rembrandt stereoblind? *The New England Journal of Medicine*, *351*, 1264–1265.

LoBue, V., Rakison, D. H., & DeLoache, J. S. (2010). Threat perception across the life span: Evidence for multiple converging pathways. *Current Directions in Psychological Science*, *19*, 375–379.

Lochte, B. C., Guillory, S. A., Richard, C. A. H., & Kelley, W. M. (2018). An fMRI investigation of the neural correlates underlying the autonomous sensory meridian response (ASMR). *Bioimpacts*, *8*, 295–304.

Locksley, A., Ortiz, V., & Hepburn, C. (1980). Social categorization and discriminatory behavior: Extinguishing the minimal intergroup discrimination effect. *Journal of Personality and Social Psychology*, *39*, 773–783.

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, *127*, 267–286.

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology*, *7*, 560–572.

Loftus, E. F. (1997). Creating false memories. *Scientific America*, *277*, 70–75.

Loftus, E. F., & Davis, D. (2006). Recovered memories. *Annual Review of Clinical Psychology*, *2*, 469–498.

Loftus, E. F., & Palmer, J. C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 585–589.

Loftus, E. F., Loftus, G. R., & Lesso, J. (1987). Some facts about "weapon focus." *Law and Human Behavior*, *11*, 55–62.

Logan, J. M., Sanders, A. L., Snyder, A. Z., Morris, J. C., & Buckner, R. L. (2002). Under-recruitment and nonselective recruitment: Dissociable neural mechanisms associated with aging. *Neuron*, *33*, 827–840.

Logel, C., & Cohen, G. L. (2012). The role of the self in physical health: Testing the effect of a cause-affirmation intervention on weight loss. *Psychological Science*, *23*, 53–55.

Loggia, M. L., Mogil, J. S., & Bushnell, M. C. (2008a). Empathy hurts: Compassion for another increases both sensory and affective components of pain perception. *Pain*, *136*, 168–176.

Loggia, M. L., Mogil, J. S., & Bushnell, M. C. (2008b). Experimentally induced mood changes preferentially affect pain unpleasantness. *The Journal of Pain*, *9*, 784–791.

Logothetis, N. K., Pauls, J., Augath, M., Trinath, T., & Oeltermann, A. (2001). Neurophysiological investigation of the basis of the fMRI signal. *Nature*, *412*, 150–157.

Lømo, T. (1966). Frequency potentiation of excitatory synaptic activity in the dentate area of the hippocampal formation. *Acta Physiological Scandinavica*, *68*, 128.

Lorenzoni, I., & Pidgeon, N. F. (2006). Public views on climate change: European and USA perspectives. *Climatic Change*, *77*, 73–95.

Losin, E. A. R., Dapretto, M., & Lacoboni, M. (2010). Culture and neuroscience: Additive or synergistic? *Social, Cognitive, and Affective Neuroscience*, *5*, 148–158.

Lougheed, J. P., & Hollenstein, T. (2012). A limited repertoire of emotion regulation strategies is associated with internalizing problems in adolescence. *Social Development*, *21*, 704–721.

Love, T., Laier, C., Brand, M., Hatch, L., & Hajela, R. (2015). Neuroscience of internet pornography addiction: A review and update. *Behavioral Sciences*, *5*, 388–433.

Lovett, M. W., Lacerenza, L., De Palma, M., & Frijters, J. C. (2012). Evaluating the efficacy of remediation for struggling readers in high school. *Journal of Learning Disabilities*, *45*, 151–169.

Low, B. S. (1979). Sexual selection and human ornamentation. In N. Chagnon, & W. Irons (Eds.), *Evolutionary biology and human social behaviour* (pp. 462–487). North Slituate, MA: Duxbury Press.

Lubman, D. I., Cheetham, A., & Yücel, M. (2015). Cannabis and adolescent brain development. *Pharmacology & Therapeutics*, *148*, 1–16.

Lubow, R. E., & Moore, A. U. (1959). Latent inhibition: The effect of non-reinforced preexposure to the conditioned stimulus. *Journal of Comparative and Physiological Psychology*, *52*, 415–419.

Lucas, R. E., Diener, E., Grob, A., Suh, E. M., & Shao, L. (2000). Cross-cultural evidence for the fundamental features of extraversion. *Journal of Personality and Social Psychology*, *79*, 452–468.

Luck, A., Pearson, S., Maddern, G., & Hewett, P. (1999). Effects of video information on precolonoscopy anxiety and knowledge: A randomised trial. *Lancet*, *354*, 2032–2035.

Luders, E., Narr, K., Bilder, R., Szeszko, P., Gurbani, ... Gaser, C. (2008). Mapping the relationship between cortical convolution and intelligence: Effects of gender. *Cerebral Cortex*, *18*, 2019–2026.

Ludewig, S., Ludewig, K., Hasler, F., & Vollenweider, F. X. (2003). No lasting effects of moderate doses of MDMA (Ecstasy) on memory performance and mood states in healthy humans. *Biological Psychiatry*, *53 (Supplement*), 205S.

Luo, L., & Craik, F. I. (2008). Aging and memory: A cognitive approach. *Canadian Journal of Psychiatry*, *53*, 346–353.

Lutgendorf, S. K., Costanzo, E., & Siegel, S. (2007). Psychosocial influences in oncology: An expanded model of biobehavioral mechanisms. In R. Ader, R. Glaser, N. Cohen, & M. Irwin (Eds.), *Psychoneuroimmunology* (4th ed., pp. 869–895). New York: Academic Press.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*, *12*, 163–169.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*, *12*, 163–169.

Lynn, S. J., & Kirsch, I. (1996). False memories, hypnosis, and fantasy-proneness. *Psychological Inquiry*, *7*, 151–155.

Lynn, S., Nash, M., Rhue, J., Frauman, D., & Sweeney, C. (1984). Nonvolition, expectancies, and hypnotic rapport. *Journal of Abnormal Psychology*, *93*, 295–303.

Lyons, B. D., Hoffman, B. J., & Michel, J. W. (2009). Not much more than *g*? An examination of the impact of intelligence on NFL performance. *Human Performance*, *22*, 225–245.

Lyons, N. P. (1983). Two perspectives: On self, relationships, and morality. *Harvard Educational Review*, *53*, 125–145.

Lyons, R. (2011). The spread of evidence-poor medicine via flawed social-network analysis. *Statistics, Politics, and Policy*. *2*(1). doi: 10.2202/2151-7509.1024

Lyznicki, J. M., Doege, T. C., Davis, R. M., & Williams, M. A. (1998). Sleepiness, driving, and motor vehicle crashes. *Journal of the American Medical Association*, *279*, 1908–1913.

Ma, G., Fan, H., Shen, C., & Wang, W. (2016). Genetic and neuroimaging features of personality disorders: State of the art. *Neuroscience Bulletin*, *32*, 286–306.

MacCracken, M. J., & Stadulis, R. E. (1985). Social facilitation of young children's dynamic balance performance. *Journal of Sport Psychology*, *7*, 150–165.

MacDonald, A. A., Naci, L., MacDonald, P. A., & Owen, A. M. (2015). Anesthesia and neuroimaging: Investigating the neural correlates of unconsciousness. *Trends in Cognitive Science*, *19*, 100–107.

Macdonald, K., & Macdonald, T. M. (2010). The peptide that binds: A systematic review of oxytocin and its prosocial effects in humans. *Harvard Review of Psychiatry*, *18*, 1–21.

MacDonald, T. K., & Martineau, A. M. (2002). Self-esteem, mood, and intentions to use condoms: When does low self-esteem lead to risky health behaviors? *Journal of Experimental Social Psychology*, *38*, 299–306.

Machado Rocha, F. C., Stéfano, S. C., De Cássia Haiek, R., Rosa Oliveira, L. M., & Da Silveira, D. X. (2008). Therapeutic use of Cannabis sativa on chemotherapy-induced nausea and vomiting among cancer patients: Systematic review and meta-analysis. *European Journal of Cancer Care*, *17*, 431–443.

Machón, R. A., Huttunen, M. O., Mednick, S. A., Sinivuo, J., Tanskanen, A., ... Pyhälä, R. (2002). Adult schizotypal personality characteristics and prenatal influenza in a Finnish birth cohort. *Schizophrenia Research*, *54*, 7–16.

Mack, A., & Rock, I. (1998). *Inattentional blindness*. Cambridge, MA: MIT Press.

MacLean, K. A., Johnson, M. W., & Griffiths, R. R. (2011). Mystical experiences occasioned by the hallucinogenic psilocybin lead to increases in the personality domain of openness. *Journal of Psychopharmacology*, *25*, 1453–1461.

Maclean, P. D. (1952). Some psychiatric implications of physiological studies on frontotemporal portion of limbic system (visceral brain). *Electroencephalography and Clinical Neurophysiology*, *4*, 407–418.

Macmillan, M. (2008). Phineas Gage: Unravelling the myth. *The Psychologist*, *21*, 828–839.

Madden, D. J., Turkington, T. G., Coleman, R. E., Provenzale, J. M., DeGrado, T. R., & Hoffman, J. M. (1996). Adult age differences in regional cerebral blood flow during visual world identification: Evidence from H215O PET. *NeuroImage*, *3*, 127–142.

Maddux, W. W., Mullen, E., & Galinsky, A. D. (2008). Chameleons bake bigger pies and take bigger pieces: Strategic behavioral mimicry facilitates negotiation outcomes. *Journal of Experimental Social Psychology*, *44*, 461–468.

Madill, A., & Gough, B. (2008). Qualitative research and its place in psychological science. *Psychological Methods*, *13*, 254–271.

Maes, H. H., Neale, M. C., & Eaves, L. J. (1997). Genetic and environmental factors in relative body weight and human adiposity. *Behavioral Genetics*, *27*, 325–351.

Magri, C., Schridde, U., Murayama, Y., Panxeri, S., Logothetis, N. K. (2012). The amplitude and timing of the BOLD signal reflects the relationship between local field potential power at different frequencies. *Journal of Neuroscience*, *32*, 1395–1407.

Mahalik, J., Good, G., & Englar-Carlson, M. (2003). Masculinity scripts, presenting concerns, and help seeking: Implications for practice and training. *Professional Psychology: Research and Practice*, *34*, 123–131.

Mahon, M., & Crutchley, A. (2006). Performance of typically-developing school-age children with English as an additional language on the British Picture Vocabulary Scales II. *Child Language Teaching and Therapy*, *22*, 333–351.

Mai, L. M., Freudenthaler, R., Schneider, F. M., & Vorderer, P. (2015). "I know you've seen it!" Individual and social factors for users' chatting behavior on Facebook. *Computers in Human Behavior*, *49*, 296–302.

Maier, N. F. (1931). Reasoning in humans. II. The solution of a problem and its appearance in consciousness. *Journal of Comparative Psychology*, *12*, 181–194.

Maier, N. R. F. (1930). Reasoning in humans: On direction. *Journal of Comparative Psychology*, *10*, 115–143.

Maier, S. F., & Seligman, M. E. (2016). Learned helplessness at fifty: Insights from neuroscience. *Psychological Review*. *123*, 349–367.

Maier, S. F., & Watkins, L. R. (1998). Cytokines for psychologists: Implications of bidirectional immune-to-brain communication for understanding behavior, mood, and cognition. *Psychological Review*, *105*, 83–107.

Maier, S. F., & Watkins, L. R. (2005). Stressor controllability and learned helplessness: The roles of the dorsal raphe nucleus, serotonin, and corticotrophin-releasing factor. *Neuroscience and Behavioral Reviews*, *29*, 829–841.

Main, M., & Solomon, J. (1990). Procedures for identifying disorganized/disoriented infants during the Ainsworth Strange Situation. In M. Greenberg, D. Cicchetti, & M. Cummings (Eds.), *Attachment in the preschool years*, (pp. 121–160). Chicago: University of Chicago Press.

Makin, J., Fried, P. A., & Watkinson, B. (1991). A comparison of active and passive smoking during pregnancy: Long-term effects. *Neurotoxicology and Teratology*, *13*, 5–12.

Makino, M., Tsuboi, K., & Dennerstein, L. (2004). Prevalence of eating disorders: A comparison of Western and non-Western countries. *Medscape General Medicine*, *6*, 49.

Makovac, E., Meeten, F., Watson, D. R., Garfinkel, S. N., Critchley, H. D., & Ottaviana, C. (2016). Neurostructural abnormalities associated with axes of emotion dysregulation in generalized anxiety. *NeuroImage: Clinical*, *10*, 172–181.

Malberg, J. E., Eisch, A. J., Nestler, E. J., & Duman, R. S. (2000). Chronic antidepressant treatment increases neurogenesis in adult rat hippocampus. *Journal of Neuroscience*, *20*, 9104–9110.

Mampe, B., Friederici, A. D., Christophe, A., & Wermke, K. (2009). Newborns' cry melody is shaped by their native language. *Current Biology*, *19*, 1994–1997.

Mangels, J. A., Butterfield, B., Lamb, J., Good, C., & Dweck, C. S. (2006). Why do beliefs about intelligence influence learning success? A social cognitive neuroscience model. *Social, Cognitive, and Affective Neuroscience*, *1*, 75–86.

Mangun, G. R., Hillyard, S. A., & Luck, S. J. (1993). Electrocortical substrates of visual selective attention. In D. Meyer & S. Kornblum (Eds.). *Attention and performance 14: Synergiesin experimental psychology, artificial intelligence, and cognitive neuroscience* (pp. 219–243). Cambridge, MA: MIT Press.

Manning, R., Levine, M., & Collins, A. (2007). The Kitty Genovese murder and the social psychology of helping: The parable of the 38 witnesses. *American Psychologist*, *62*, 555–562.

Mansfield, A. K., Addis, M. E., & Courtenay, W. (2005). Measurement of men's help seeking: Development and evaluation of the barriers to help seeking scale. *Psychology of Men & Masculinity*, *6*, 95–108.

Manzouri, A., & Savic, I. (2018a). Multimodal MRI suggests that male homosexuality may be linked to cerebral midline structures. *PLoS ONE*, *13*, e0203189.

Manzouri, A., & Savic, I. (2018b). Cerebral sex dimorphism and sexual orientation. *Human Brain Mapping*, *39*, 1175–1186.

Marconi, A., Di Forti, M., Lewis, C. M., Murray, R. M., & Vassos, E. (2016). Meta-analysis of the association between the level of cannabis use and risk of psychosis. *Schizophrenia Bulletin*, *42*, 1262–1269.

Marek, R., Strobel, C., Bredy, T. W., & Sah, P. (2013). The amygdala and medial prefrontal cortex: Partners in the fear circuit. *Journal of Physiology*, *591*, 2381–2391.

Maren, S. (2001). Neurobiology of Pavlovian fear conditioning. *Annual Review of Neuroscience*, *24*, 897–931.

Marino, L. (2002). Convergence of complex cognitive abilities in cetaceans and primates. *Brain, Behavior, and Evolution*, *59*, 21–32.

Mark, V. W., Woods, A. J., Mennemeier, M., Abbas, S., & Taub, E. (2006). Cognitive assessment for CI therapy in the outpatient clinic. *NeuroRehabilitation*, *21*, 139–146.

Marks, G., & Miller, N. (1987). Ten years of research on the false-consensus effect: An empirical and theoretical review. *Psychological Bulletin*, *102*, 72–90.

Marks, L. V. (2001). *Sexual chemistry: A history of the contraceptive pill*. New Haven: Yale University Press.

Markus, H. (1977). Self-schema and processing information about the self. *Personality and Social Psychology Bulletin*, *35*, 63–78.

Markus, H., Uchida, Y., Omoregie, H., Townsend, S., & Kitayama, S. (2006). Going for the gold: Models of agency in Japanese and American contexts. *Psychological Science*, *17*, 103–112.

Markus, H. R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review*, *98*, 224–253.

Markus, H. R., & Kitayama, S. (2003). Models of agency: Sociocultural diversity in the construction of action. In V.M. Berman & J.J. Berman (Eds.), *Nebraska symposium on motivation: Cross-cultural differences in perspectives on the self* (Vol. 49, pp. 1–58). Lincoln: University of Nebraska Press.

Marner, L., Nyengaard, J. R., Tang, Y., & Pakkenberg, B. (2003). Marked loss of myelinated nerve fibers in the human brain with age. *Journal of Comparative Neurology*, *462*, 144–152.

Marois, R., & Ivanoff, J. (2005). Capacity limits of information processing in the brain. *Trends in Cognitive Sciences*, *46*, 774–785.

Maron, E., & Nutt, D. (2017). Biological markers of generalized anxiety disorder. *Dialogues in Clinical Neuroscience*, *19*, 147–158.

Marotta, J. J., Genovese, C. R., & Behrmann, M. (2001). A functional MRI study of face recognition in patients with prosopagnosia. *Neuroreport*, *12*, 1581–1587.

Marroun, H. E., Schmidt, M. N., Franken, I. H. A., Jaddoe, V. W. V., Hofman, A., ... White, T. (2014). Prenatal tobacco exposure and brain morphology: A prospective study in young children. *Neuropsychopharmacology*, *39*, 792–800.

Martin, A., Wiggs, C. L., Ungerleider, L. G., & Haxby, J. V. (1996). Neural correlates of category-specific knowledge. *Nature*, *379*, 649–652.

Martin, L. (1986). "Eskimo words for snow": A case study in the genesis and decay of an anthropological example. *American Anthropologist*, *88*, 418–423.

Martin, R. A. (2002). Is laughter the best medicine? Humor, laughter and physical health. *Current Directions in Psychological Science*, *11*, 216–220.

Martin, R. A. (2007). *The psychology of humor: An integrative approach*. Burlington, MA: Elsevier Academic Press.

Martín-Santos, R., Fagundo, A. B., Crippa, J. A., Atakan, Z., Bhattacharyya, S., Allen, P., et al. (2010). Neuroimaging in cannabis use: A systematic review of the literature. *Psychological Medicine*, *40*, 383–398.

Martinez, D., & Narendran, R. (2010). Imaging neurotransmitter release by drugs of abuse. *Current Topics in Behavioral Neuroscience*, *3*, 219–245.

Maruff, P., Falleti, M. G., Collie, A., Darby, D., & McStephen, M. (2005). Fatigue-related impairment in the speed, accuracy and variability of psychomotor performance: Comparison with blood alcohol levels. *Journal of Sleep Research*, *14*, 21–27.

Maruta, T., Colligan, R. C., Malinchoc, M., & Offord, K. P. (2000). Optimists vs pessimists: Survival rate among medical patients over a 30-year period. *Mayo Clinic Proceedings*, *75*, 140–143.

Mashhoon, Y., Sava, S., Sneider, J. T., Nickerson, L. D., & Silveri, M. M. (2015). Cortical thinness and volume differences associated with marijuana abuse in emerging adults. *Drug and Alcohol Dependence*, *155*, 275–283.

Maslow, A. (1943). A theory of human motivation. *Psychological Review*, *50*, 370–396.

Maslow, A. (1954). *Motivation and personality*. New York: Harper and Row.

Maslow, A. (1968). *Toward a psychology of being* (2nd ed.). New York: Van Nostrand.

Maslow, A. (1970). *Motivation and personality*. New York: Harper & Row.

Masters, W., & Johnson, V. (1966). *Human sexual response*. Oxford, UK: Little, Brown.

Masuda, A., Suzumura, K., Beauchamp, K., Howells, G., & Clay, C. (2005). United States and Japanese college students' attitudes toward seeking professional psychological help. *International Journal of Psychology*, *40*, 303–313.

Masuda, T., Ellsworth, P. C., Mesquita, B., Leu, J., Tanida, S., & van de Veerdonk, E. (2008). Placing the face in context: Cultural differences in the perception of facial emotion. *Journal of Personality and Social Psychology*, *94*, 365–381.

Masuda, T., Wang, H., Ishii, K., & Ito, K. (2012). Do surrounding figures' emotions affect judgment of the target figure's emotion? Comparing the eye-movement patterns of European Canadians, Asian Canadians, Asian international students, and Japanese. *Frontiers in Integrative Neuroscience*, *6*, article 72.

Mather, J. A., & Anderson, R. C. (1993). Personalities of octopuses (*Octopus rubescens*). *Journal of Comparative Psychology*, *107*, 336–340.

Matsumoto, D., Consolacion, T., Yamada, H., Suzuki, R., Franklin, B., ... Uchida, H. (2002). American–Japanese cultural differences in judgements of emotional expressions of different intensities. *Cognition & Emotion*, *16*, 721–747.

Matsunaga, H., Kaye, W. H., McConaha, C., Plotnicov, K., Pollice, C., & Rao, R. (2000). Personality disorders among subjects recovered from eating disorders. *International Journal of Eating Disorders*, *27*, 353–357.

Matthews, A., Herrett, E., Gasparrini, A., Van Staa, T., Goldacre, B., ... Bhaskaran, K. (2016). Impact of statin related media coverage on use of statins: Interrupted time series analysis with UK primary care data. *British Medical Journal*, *353*, i3283.

Matthews, K., & Gump, B. B. (2002). Chronic work stress and marital dissolution increase risk of posttrial mortality in men from the Multiple Risk Factor Intervention Trial. *Archives of Internal Medicine*, *162*, 309–315.

Mattson, M. P. (2000). Neuroprotective signaling and the aging brain: Take away my food and let me run. *Brain Research*, *886*, 47–53.

Matute, H., & Blanco, F. (2014). Reducing the illusion of control when an action is followed by an undesired outcome. *Psychonomic Bulletin & Review*, *21*, 1087–1093.

Maurer, D., & Maurer, C. (1988). *The world of the newborn*. New York: Basic Books.

Maxwell, A. (2015). Adult criminal court statistics in Canada, 2013/2014. Statistics Canada Catalogue no. 85-002-X. Ottawa: Statistics Canada.

Mayberg, H. S., Liotti, M., Brannan, S. K., McGinnis, S., Mahurin, R. K., ... Fox, P. T. (1999). Reciprocal limbic-cortical function and negative mood: Converging PET findings in depression and normal sadness. *American Journal of Psychiatry*, *156*, 675–682.

Mayberg, H. S., Lozano, A. M., Voon, V., Mcneely, H. E., Seminowicz, D., ... Kennedy, S. H. (2005). Deep brain stimulation for treatment-resistant depression. *Neuron*, *45*, 651–660.

Mayer, G. (2012). The use of sodium oxybate to treat narcolepsy. *Expert Review of Neurotherapeutics*, *12*, 519–529.

Mazur, A., & Booth, A. (1998). Testosterone and dominance in men. *Behavioral and Brain Sciences*, *21*, 353–363.

Mazur, A., Booth, A., & Dabbs, Jr., J. M. (1992). Testosterone and chess competition. *Social Psychology Quarterly*, *55*, 70–77.

McAnulty, G., Duffy, F. H., Butler, S., Bernstein, J. H., Zurakowski, D., & Als, H. (2010). Effects of newborn individualized developmental care and assessment program (NIDCAP) at age 8 years: Preliminary data. *Clinical Pediatrics (Philadelphia)*, *49*, 258–270.

McAnulty, G., Duffy, F. H., Butler, S., Parad, R., Ringer, S., ... Als, H. (2009). Individualized developmental care for a large sample of very preterm infants: Health, neurobehaviour and neurophysiology. *Acta Paediatrica*, *98*, 1920–1926.

McClure, S. M., Laibson, D. I., Loewenstein, G., & Cohen, J. D. (2004). Separate neural systems value immediate and delayed monetary rewards. *Science*, *306*, 503–507.

McCormick, L. M., Keel, P. K., Brumm, M. C., Bowers, W., Swayze, V., ... Andreasen, N. (2008). Implications of starvation-induced change in right dorsal anterior cingulate volume in anorexia nervosa. *International Journal of Eating Disorders*, *41*, 602–610.

McCoy, A. (2006). *A question of torture: CIA interrogation from the Cold War to the War on Terror*. New York: Metropolitan Books.

McCrae, R. R. (2001). Trait psychology and culture. *Journal of Personality*, *69*, 819–846.

McCrae, R. R., & Costa, P. (1987). Validation of the Five-Factor Model of personality across instruments and observers. *Journal of Personality and Social Psychology*, *52*, 81–90.

McCrae, R. R., & Costa, P. T. (1990). *Personality in adulthood*. New York: The Guildford Press.

McCrae, R. R., Terracciano, A., & Personality Profiles of Cultures Project. (2005). Personality profiles of cultures: Aggregate personality traits. *Journal of Personality and Social Psychology*, *89*, 407–425.

McCulloch, J., Bullock, R. & Teasdale, G. M. (1991). Excitatory amino acid antagonists: Opportunities for the treatment of ischaemic brain damage in man. In B.S. Meldrum (Ed), *Excitatory amino acid antagonists* (pp. 287–325). Oxford: Blackwell.

McCullough, J. P. (2000). *Treatment for chronic depression: Cognitive behavioral analysis system of psychotherapy (CBASP*). New York: Guilford Press.

McCullough, M. E., & Willoughby, B. L. (2009). Religion, self-regulation, and self-control: Associations, explanations, and implications. *Psychological Bulletin*, *135*, 69–93.

McCullough, M. E., Hoyt, W. T., Larson, D. B., Koenig, H. G., & Thoresen, C. E. (2000). Religious involvement and mortality: A meta-analytic review. *Health Psychology*, *19*, 211–222.

McDaid, C., Duree, K. H., Griffin, S. C., Weatherly, H. L. A., Stradling, J. R., Davies, J. O., et al. (2009). A systematic review of continuous positive airway pressure for obstructive sleep apnoea–hypopnoea syndrome. *Sleep Science Reviews*, *13*, 427–436.

McEwen, B. S. (2000). The neurobiology of stress: From serendipity to clinical relevance. *Brain Research*, *886*, 172–189.

McGeown, W. J., Mazzoni, G., Venneri, A., Kirsch, I. (2009). Hypnotic induction decreases anterior default mode activity. *Consciousness and Cognition*, *18*, 848–855.

McGlashan, T. H., Zipursky, R. B., Perkins, D., Addington, J., Miller, T., & Woods, S. W. (2006). Randomized double-blind clinical trial of olanzapine versus placebo in patients prodromally symptomatic for psychosis. *American Journal of Psychiatry*, *163*, 790–799.

McGorry, P. D., Yung, A. R., Phillips, L. J., Yuen, H. P., Francey, S., & Cosgrave, E. M. (2002). Randomized controlled trial of interventions designed to reduce the risk of progression to first-episode psychosis in a clinical sample with subthreshold symptoms. *Archives of General Psychiatry*, *59*, 921–928.

McGraw, A.P., Warren, C., Williams, L., & Leonard, B., (2012). Too close for comfort, or too far to care? Finding humor in distant tragedies and close mishaps. *Psychological Science*, *25*, 1215–1223.

McGruder, J. (2004). Disease models of mental illness and aftercare patient education: Critical observations from meta-analyses, cross-cultural practice and anthropological study. *British Journal of Occupational Therapy*, *67*, 310–318.

McGuire, W. J. (1961). The effectiveness of supportive and refutational defenses in immunizing defenses. *Sociometry*, *24*, 184–197.

McGurk, H, & MacDonald, J. (1976). Hearing lips and seeing voices. *Nature*, *264*, 746–748.

McKenzie-Mohr, D. (2000). Promoting sustainable behavior: An introduction to community-based social marketing. *Journal of Social Issues*, *56*, 543–554.

McLaughlin, K. A., Hatzenbuehler, M. L., Mennin, D. S., & Nolen-Hoeksema, S. (2011). Emotion dysregulation and adolescent psychopathology: A prospective study. *Behaviour Research and Therapy*, *49*, 544–554.

McLay, R. N., Wood, D. P., Webb-Murphy, J. A., Spira, J. L., Wiederhold, M. D., ... Wiederhold, B. K. (2011). A randomized, controlled trial of virtual reality exposure therapy for post-traumatic stress disorder in active duty service members with combat-related post-traumatic stress disorder. *Cyberpsychology, Behavior, and Social Networking*, *14*, 223–229.

McManus, F., Surawy, C., Muse, K., Vazquez-Montes, M., & Williams, J. M. G. (2012). A randomized clinical trial of mindfulness-based cognitive therapy versus unrestricted services for health anxiety (hypochondriasis). *Journal of Consulting and Clinical Psychology*, *80*, 817–828.

McNally, R. J., Lasko, N. B., Clancy, S. A., Macklin, M. L., Pitman, R. K., & Orr, S. P. (2004). Psychophysiological responding during script-driven imagery in people reporting abduction by space aliens. *Psychological Science*, *15*, 493–497.

McNeely, H. E., Mayberg, H. S., Lozano, A. M., & Kennedy, S. H. (2008). Neuropsychological impact of Cg25 deep brain stimulation for treatment-resistant depression: Preliminary results over 12 months. *Journal of Nervous and Mental Disease*, *196*, 405–410.

McVey, G. L., Gusella, J., Tweed, S., & Ferrari, M. (2009). A controlled evaluation of web-based training for teachers and public health practitioners on the prevention of eating disorders. *Eating Disorders: Journal of Treatment and Prevention*, *17*, 1–26.

Mead, M. (1928). *Coming of age in Samoa: A psychological study of primitive youth for Western civilization*. Oxford, UK: William Morrow.

Mededović, J., & Petrovic, B. (2015). The dark tetrad. *Journal of Individual Differences*, *36*, 228–236.

Mednick, S. A., Huttunen, M. O., & Machón, R. A. (1994). Prenatal influenza infections and adult schizophrenia. *Schizophrenia Bulletin*, *20*, 263–267.

Meehl, P. E. (1967). Theory-testing in psychology and physics: A methodological paradox. *Philosophy of Science*, *34*, 103–115.

Mehl, M. R., Gosling, S. D., & Pennebaker, J. W. (2006). Personality in its natural habitat: Manifestations and implicit folk theories of personality in daily life. *Journal of Personality and Social Psychology*, *90*, 862–877.

Mehler, J., & Bever, T. G. (1967). Cognitive capacity of very young children. *Science*, *158*, 141–142.

Meier, M. H., Slutske, W. S., Arndt, S., & Cadoret, R. J. (2008). Impulsive and callous traits are more strongly associated with delinquent

behavior in higher risk neighborhoods among boys and girls. *Journal of Consulting and Clinical Psychology*, *117*, 377–385.

Melby-Lervåg, M., & Hulme, C. (2013). Is working memory training effective? A meta-analytic review. *Developmental Psychology*, *49*, 270–291.

Meldrum, B. S. (2000). Glutamate as a neurotransmitter in the brain: Review of physiology and pathology. *Journal of Nutrition*, *130*, 1007S–1015S.

Meletti, S., Vaudano, A. E., Pizza, F., Ruggieri, A., Vandi, S., Teggi, A., … Plazzi, G. (2015). The brain correlates of laugh and cataplexy in childhood narcolepsy. *The Journal of Neuroscience*, *35*, 11583–11594.

Meloni, M. (2014). The social brain meets the reactive genome: neuroscience, epigenetics and the new social biology. *Frontiers in Human Neuroscience*, *8*, article 309.

Meltzoff, A. N. (1988). Infant imitation and memory: Nine-month-olds in immediate and deferred tests. *Child Development*, *59*, 217–225.

Melzack, R., & Katz, J. (2013). Pain. *Wiley Interdisciplinary Reviews: Cognitive Science*, *4*, 1–15.

Melzack, R., & Wall, P. D. (1965). Pain mechanisms: A new theory. *Science*, *150*, 971–979.

Melzack, R., & Wall, P. D. (1982). *The challenge of pain*. New York: Basic Books.

Memmert D., & Furley, P. (2007). "I spy with my little eye!": Breadth of attention, inattentional blindness, and tactical decision making in team sports. *Journal of Sport and Exercise Psychology*, *29*, 365–347.

Mendes, N., Steinbeis, N., Bueno-Guerra, N., Call, J., & Singer, T. (2017). Preschool children and chimpanzees incur costs to watch punishment of antisocial others. *Nature Human Behaviour*, *2*, 45–51.

Mental Health Commission of Canada. (2014). Why investing in mental health will contribute to Canada's economic prosperity and to the sustainability of our health care system. Retrieved from www.mentalhealthcommission.ca/English/node/742.

Menzies, L., Chamberlain, S. R., Laird, A. R., Thelen, S. M., Sahakian, B. J., & Bullmore, E. T. (2008). Integrating evidence from neuroimaging and neuropsychological studies of obsessive-compulsive disorder: The orbitofronto-striatal model revisited. *Neuroscience & Biobehavioral Reviews*, *32*, 525–549.

Merchant, H., Grahn, J., Trainor, L., Rohrmeier, M., & Fitch, W. T. (2015). Finding the beat: A neural perspective across humans and non-human primates. *Philosophical Transactions of the Royal Society of London B*, *370*, 1–16.

Merckelbach, H., de Jong, P. J., Muris, P., & van den Hout, M. A. (1996). The etiology of specific phobias. *Clinical Psychology Review*, *16*, 337–

361.

Merikle, P. M., & Daneman, M. (1996). Memory for unconsciously perceived events: Evidence from anesthetized patients. *Consciousness and Cognition*, *5*, 525–541.

Merikle, P. M., & Skanes, H. E. (1992). Subliminal self-help audiotapes: A search for placebo effects. *Journal of Applied Psychology*, *77*, 772–776.

Messer, D. (2000). State of the art: Language acquisition. *The Psychologist*, *13*, 138–143.

Meston, C. M., & Ahrold, T. (2010). Ethnic, gender, and acculturation influences on sexual behaviors. *Archives of Sexual Behavior*, *39*, 179–189.

Meston, C. M., & Buss, D. M. (2007). Why humans have sex. *Archives of Sexual Behavior*, *36*, 477–507.

Meston, C. M., Hamilton, L. D., & Harte, C. B. (2009). Sexual motivation in women as a function of age. *International Society for Sexual Medicine*, *6*, 3305–3319.

Meston, C. M., Levin, R. J., Sipski, M. L., Hull, E. M., & Heiman, J. R. (2004). Women's orgasm. *Annual Review of Sex Research*, *15*, 173–257.

Meyer, J. S. (2013). 3,4-methylenedioxymethamphetamine (MDMA): Current perspectives. *Substance Abuse and Rehabilitation*, *4*, 83–99.

Mezulis, A. H., Abramson, L. Y., Hyde, J. S., & Hankin, B. L. (2004). Is there a universal positivity bias in attributions? A meta-analytic review of individual, developmental, and culture differences in the self-serving attributional bias. *Psychological Bulletin*, *130*, 711–747.

Michael, E. B., & Gollan, T. H. (2005). Being and becoming bilingual: Individual differences and consequences for language production. In J.F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approach* (pp. 389–407). New York: Oxford University Press.

Mike, T. B., Shaw, D. S., Forbes, E. E., Sitnick, S. L., & Hasler, B. P. (2016). The hazards of bad sleep: Sleep duration and quality as predictors of adolescent alcohol and cannabis use. *Drug & Alcohol Dependence*, *168*, 335–339.

Mikulincer, M., & Shaver, P. R. (2005). Attachment security, compassion, and altruism. *Current Directions in Psychological Science*, *14*, 34–38.

Mikulincer, M., & Shaver, P. R. (2007). *Attachment in adulthood: Structure, dynamics, and change*. New York: Guilford Press.

Milgram, S. (1963). Behavioral study of obedience. *Journal of Abnormal and Social Psychology*, *67*, 371–378.

Milgram, S. (1974). *Obedience to authority: An experimental view*. New York: HarperCollins.

Milgram, S. (2009). *Obedience to authority: An experimental view*. New York: Harper Collins.

Miller, B. L., & Cummings, J. L. (2007). *The human frontal lobes*. New York: Guilford Press.

Miller, D. T., & Ross, M. (1975). Self-serving biases in the attribution of causality: Fact or fiction? *Psychological Bulletin*, *82*, 213–225.

Miller, G. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *63*, 81–97.

Miller, I. J., Jr., & Reedy, F. E. (1990). Variations in human taste bud density and intensity perception. *Physiology and Behavior*, *47*, 1213–1219.

Miller, L. J., Myers, A., Prinzi, L., & Mittenberg, W. (2009). Changes in intellectual functioning associated with normal aging. *Archives of Clinical Neuropsychology*, *24*, 681–688.

Milling, L. (2009). Response expectancies: A psychological mechanism of suggested and placebo analgesia. *Contemporary Hypnosis*, *26*, 93–110.

Mills, D., Coffey-Corina, S., & Neville, H. (1997). Language comprehension and cerebral specialization from 13 to 20 months. *Developmental Neuropsychology*, *13*, 397–445.

Mills, J. N. (1964). Circadian rhythms during and after three months in solitude underground. *Journal of Physiology*, *174*, 217–231.

Milner, B. (1962). Les troubles de la mémoire accompagnant des lésions hippocampiques bilatérales. In P. Passouant (Ed.), *Physiologie de l'Hippocampe* (pp. 257–272). Paris: Centre Nationale de la Recherche Scientifique.

Milner, B. (1963). Effects of different brain lesions on card sorting. *Archives of Neurology*, *9*, 90–100.

Milner, B., Corkin, S., & Teuber, H. L. (1968). Further analysis of the hippocampal amnesic syndrome: 14-year follow-up study of H.M. *Neuropsychologia 6*, 215–234.

Milner, D., & Goodale, M. A. (2006). *The visual brain in action* (2nd ed). Oxford, UK: Oxford University Press.

Mischel, W. (1968). *Personality and assessment*. New York: Wiley.

Mischel, W. (1981). *Introduction to personality*. New York: Holt, Rinehart and Winston.

Mischel, W., & Shoda, Y. (1998). Reconciling processing dynamics and personality dispositions. *Annual Review of Psychology*, *49*, 229–258.

Mishara, B. L., & Daigle, M. S. (1997). Effects of different telephone intervention styles with suicidal callers at two suicide prevention centers: An empirical investigation. *American Journal of Community Psychology*, *5*, 861–885.

Mishara, B. L., Chagnon, F., Daigle, M., Balan, B., Raymond, S., ... Berman, A. (2007). Which helper behaviors and intervention styles are related to better short-term outcomes in telephone crisis intervention? Results from a silent monitoring study of calls to the U.S. 1-800-SUICIDE Network. *Suicide and Life Threatening Behavior*, *37*, 308–321.

Mistry, K. B., Minkovitz, C. S., Strobino, D. M., & Borzekowski, D. (2007). Children's television exposure and behavioral and social outcomes at 5.5 years: Does timing of exposure matter? *Pediatrics*, *120*, 762–769.

Mitchell, R. W. (1987). A comparative-developmental approach to understanding imitation. In P. P. G. Bateson & P. H. Klopfer (Eds.), *Perspectives in Ethology* (pp. 183–215). New York: Springer.

Mithoefer, M. C., Wagner, M. T., Mithoefer, A. T., Jerome, L., & Doblin, R. (2011). The safety and efficacy of {+/-}3,4-methyl-enedioxymethamphetamine-assisted psychotherapy in subjects with chronic, treatment-resistent posttraumatic stress disorder: The

first randomized controlled pilot study. *Journal of Psychopharmacology*, *25*, 439–452.

Mithoefer, M. C., Wagner, M. T., Mithoefer, A. T., Jerome, L., Martin, S. F., ... Doblin, R. (2013). Durability of improvement in post-traumatic stress disorder symptoms and absence of harmful effects or drug dependency after 3,4-methylenedioxymethamphetamine-assisted psychotherapy: A prospective long-term follow-up study. *Journal of Psychopharmacology*, *27*, 28–39

Miyake, Y., Okamoto, Y., Onoda, K., Shirao, N., Okamoto, Y., ... Yamawaki, S. (2010). Neural processing of negative word stimuli concerning body image in patients with eating disorders: An fMRI study. *NeuroImage*, *15*, 1333–1339.

Mizushige, T., Inoue, K., & Fushiki, T. (2007). Why is fat so tasty? Chemical reception of fatty acid on the tongue. *Journal of Nutritional Science and Vitaminology*, *53*, 1–4.

Molina, J., & Mendoza, M. (2006). Change of attitudes towards hypnosis after a training course. *Australian Journal of Clinical & Experimental Hypnosis*, *34*, 146–161.

Molitor, S. J., & Langberg, J. M. (2017). Using task performance to inform treatment planning for youth with ADHD : A systematic review. *Clinical Psychology Review*, *58*, 157–173.

Molteni, R., Barnard, R. J., Ying, Z., Roberts, C. K., & Gómez-Pinilla, F. (2002). A high-fat, refined sugar diet reduces hippocampal brain-

derived neurotrophic factor, neuronal plasticity and learning. *Neuroscience*, *112*, 803–814.

Monk, C. S., Telzer, E. H., Mogg, K., Bradley, B. P., Mai, X., ... Pine, D. S. (2008). Amygdala and ventrolateral prefrontal cortex activation to masked angry faces in children and adolescents with generalized anxiety disorder. *Archives of General Psychiatry*, *65*, 568–576.

Montgomery, G. H., DuHamel, K. N., & Redd, W. H. (2000). A metaanalysis of hypnotically induced analgesia: How effective is hypnosis? *International Journal of Clinical and Experimental Hypnosis*, *48*, 138–153.

Monti, M. M., Vanhaudenhuyse, A., Coleman, M. R., Boly, M., Pickard, J. D., Tshibanda, L., et al. (2010). Willful modulation of brain activity in disorders of consciousness. *The New England Journal of Medicine*, *362*, 579–589.

Moody, C., Callahan, T. J., Aldrich, H., Gance-Cleveland, B., & Sables-Baus, S. (2017). Early initiation of newborn individualized developmental care and assessment program (NIDCAP) reduces length of stay: A quality improvement project. *Journal of Pediatric Nursing*, *32*, 59–63.

Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology*, *67*, 11–18.

Moore, L. P., Moore, J. W., & Hauck, W. E. (1982). Conditioning children's attitudes toward alcohol, smoking, and drugs. *Journal of Experimental Education*, *50*, 154–158.

Morais, A. S., Olsson, H., & Schooler, L. J. (2013). Mapping the structure of semantic memory. *Cognitive Science*, *37*, 125–145.

Morgan, C. J., Muetzelfeldt, L., & Curran, H. V. (2010). Consequences of chronic ketamine self-administration upon neurocognitive function and psychological wellbeing: A 1-year longitudinal study. *Addiction*, *105*, 12–33.

Morgan, D., Grant, K. A., Gage, H. D., Mach, R. H., Kaplan, J. R., Prioleau, O., et al. (2002). Social dominance in monkeys: Dopamine D2 receptors and cocaine self-administration. *Nature Neuroscience*, *5*, 169–174.

Morgane, P. J., Mokler, D. J., & Galler, J. R. (2002). Effects of prenatal protein malnutrition on the hippocampal formation. *Neuroscience and Biobehavioral Reviews*, *26*, 471–483.

Morgulev, E., & Galily, Y. (2018). Choking or delivering under pressure? The case of elimination games in NBA playoffs. *Frontiers in Psychology*, *9*, 979.

Morin, C., Bootzin, R., Buysse, D., Edinger, J., Espie, C., & Lichstein, K. (2006). Psychological and behavioral treatment of insomnia: Update of the recent evidence (1998–2004). *Sleep: Journal of Sleep and Sleep Disorders Research*, *29*, 1398–1414.

Morin, C. M., LeBlanc, M., Bélanger, L., Ivers, H., Mérette, C., & Savard, J. (2011). Prevalence of insomnia and its treatment in Canada. *Canadian Journal of Psychiatry*, *56*, 540–548.

Morin, L. P. (2013). Neuroanatomy of the extended circadian rhythm system. *Experimental Neurology*, *243*, 4–20.

Morin-Moncet, O., Therrien-Blanchet, J. M., Ferland, M. C., Théoret, H., & West, G. L. (2016). Action video game playing is reflected in enhanced visuomotor performance and increased corticospinal excitability. *PLoS ONE*, *11*, 1–13.

Morina, N., Ijntema, H., Meyerbr, K., & Emmelkamp, P. M. G. (2015). Can virtual reality exposure therapy gains be generalized to real-life ? A meta-analysis of studies applying behavioral assessments. *Behaviour Research and Therapy*, *74*, 18–24.

Morleo, M., Woolfall, K., Dedman, D., Mukherjee, R., Bellis, M. A., & Cook, P. A. (2011). Under-reporting of foetal alcohol spectrum disorders: An analysis of hospital episode statistics. *BMC Pediatrics*, *11*, 14.

Morris, G., Nevet, A., Arkadir, D., Vaadia, E., & Bergman, H. (2006). Midbrain dopamine neurons encode decisions for future action. *Nature Neuroscience*, *9*, 1057–1063.

Morris, M. W., & Peng, K. (1994). Culture and cause: American and Chinese attributions for social and physical events. *Journal of*

Personality and Social Psychology, *67*, 949–971.

Morris, R. G. M. (1981). Spatial localization does not require the presence of local cues. *Learning and Motivation*, *2*, 239–260.

Morris, R. G. M., Garrud, P., Rawlins, J. N., & O'Keefe, J. (1982). Place navigation impaired in rats with hippocampal lesions. *Nature*, *297*, 681–683.

Moscicki, E. K. (2001). Epidemiology of completed and attempted suicide: Toward a framework for prevention. *Clinical Neuroscience Research*, *1*, 310–323.

Motet, A. (1897). Accès de somnambulisme spontané et provoqué. *Annales d'Hygiene et de Médecine Légale*, 3e série, *37*, 502–525. Cited in L. Thoinot (1911), *Medicolegal aspects of moral offenders*. Philadelphia, PA: Weysse A. David and Company.

Mott, F. W. (1907). Bilateral lesion of the auditory cortical centre: Complete deafness and aphasia. *British Medical Journal*, *2*, 310–315.

Mrazek, M. D., Smallwood, J., Franklin, M. S., Chin, J. M., Baird, B., & Schooler, J. W. (2012). The role of mind-wandering in measurements of general aptitude. *Journal of Experimental Psychology: General*, *141*, 788–798.

Muckle, G., Laflamme, D., Gagnon, J., Boucher, O., Jacobson, J. L., & Jacobson, S. W. (2011). Alcohol, smoking, and drug use among

Inuit women of childbearing age during pregnancy and the risk to children. *Alcoholism: Clinical and Experimental Research*, *35*, 1081–1091.

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology*, *75*, 33–52.

Mueller, F., Lenz, C., Steiner, M., Dolder, P. C., Walter, M., Lang, U. E., … Borgwardt, S. (2016). Neuroimaging in moderate MDMA use: A systematic review. *Neuroscience and Biobehavioral Reviews*, *62*, 21–34.

Müller, N. G., & Knight, R. T. (2006). The functional neuroanatomy of working memory: Contributions of human brain lesion studies. *Neuroscience*, *139*, 51–58.

Munt, S. (1998). *Heroic desire: Lesbian identity and cultural space*. New York: New York University Press.

Murdock, B. B. (1962). The serial position effect of free recall. *Journal of Experimental Psychology*, *64*, 482–488.

Muris, P., Merckelbach, H., Otgaar, H., & Meijer, E. (2017). The malevolent side of human nature: A meta-analysis and critical review of the literature on the dark triad (narcissism, Machiavellianism, and psychopathy). *Perspectives on Psychological Science*, *12*, 183–204.

Murphy, C., Cain, W. S., & Bartoshuk, L. M. (1977). Mutual action of taste and olfaction. *Sensory Processes*, *1*, 204–211.

Murphy, G. G., & Glanzman, D. L. (1997). Mediation of classical conditioning in *Aplysia californica* by LTP of sensorimotor synapses. *Science*, *278*, 467–471.

Murphy, M. R., Checkley, S. A., Seckl, J. R., & Lightman, S. L. (1990). Naloxone inhibits oxytocin release at orgasm in man. *Journal of Clinical Endocrinology and Metabolism*, *71*, 1056–1058.

Murphy, S. T., & Zajonc, R. B. (1993). Affect, cognition, and awareness: Affective priming with optimal and suboptimal stimulus exposures. *Journal of Personality and Social Psychology*, *64*, 723–739.

Murray, R. M., Bhavsar, V., Tripoli, G., & Howes, O. (2017). 30 years on: How the neurodevelopmental hypothesis of schizophrenia morphed into the developmental risk factor model of psychosis. *Schizophrenia Bulletin*, *43*, 1190–1196.

Murre, J. M. J., & Dros, J. (2015). Replication and analysis of Ebbinghaus' forgetting curve. *PLoS ONE*, *10*(7), e0120644.

Murtagh, D. R., & Greenwood, K. M. (1995). Identifying effective psychological treatments for insomnia: A meta-analysis. *Journal of Consulting and Clinical Psychology*, *63*, 79–89.

Myers, C. E., McGlinchey-Berroth, R., Warren, S., Monti, L., Brawn, C. M., & Gluck, M. A. (2000). Latent learning in medial temporal amnesia: Evidence for disrupted representational but preserved attentional processes. *Neuropsychology*, *14*, 3–15.

Myers, D. G., & Diener, E. (1995). Who is happy? *Psychological Science*, *6*, 10–19.

Naëgelé, B., Thouvard, V., Pepin, J. L., Levy, P., Bonnet, C., Perret, ... Feuerstein, (1995). Deficits of cognitive executive functions in patients with sleep apnea syndrome. *Sleep*, *18*, 43–52.

Nairne, J. S. (1996). Short-term/working memory. In E. Bjork & R. A. Bjork (Eds.), *Memory* (pp. 101–126). San Diego, CA: Academic Press.

Nakamura, M., Kanbayashi, T., Sugiura, T., & Inoue, Y. (2011). Relationship between clinical characteristics of narcolepsy and CSF orexin-A levels. *Journal of Sleep Research*, *20*, 45–49.

Nakao, T., Okada, K., & Kanba, S. (2014). Neurobiological model of obsessive-compulsive disorder: Evidence from recent neuropsychological and neuroimaging findings. *Psychiatry and Clinical Neurosciences*, *68*, 587–605.

Nakao, T., Radua, J., Rubia, K., & Mataix-Cols, D. (2011). Gray matter volume abnormalities in ADHD: voxel-based meta-analysis exploring the effects of age and stimulant medication. *American Journal of Psychiatry*, *168*, 1154–1163.

Narby, D. J., Cutler, B. L., & Moran, G. (1993). A meta-analysis of the association between authoritarianism and jurors' perceptions of defendant culpability. *Journal of Applied Psychology*, *78*, 34–42.

Nash, M. R., Perez, N., Tasso, A., & Levy, J. L. (2009). Clinical research on the utility of hypnosis in the prevention, diagnosis, and treatment of medical and psychiatric disorders. *International Journal of Clinical and Experimental Hypnosis*, *57*, 443–450.

Nash, R., Wade, K., & Lindsay, D. (2009). Digitally manipulating memory: Effects of doctored videos and imagination in distorting beliefs and memories. *Memory & Cognition*, *37*, 414–424.

National Academy of Sciences. (2018). Public health consequences of E-cigarettes. Retrieved from http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx

National Eating Disorders Association. (2002). National eating disorders association statistics: Eating disorders and their precursors. Retrieved from www.nationaleatingdisorders.org/nedaDir/files/documents/handouts/Stats.pdf

National Institute of Mental Health (NIMH). (2008). The numbers count: Mental disorders in America. Retrieved from www.nimh.nih.gov/health/publications/the-numbers-count-mental-disorders-in-america/index.shtml

National Institute of Mental Health (NIMH). (2009). Post-traumatic stress disorder (PTSD). Retrieved from www.nimh.nih.gov/health/publications/post-traumatic-stress-disorder-ptsd/psychotherapy.shtml

National Institute of Mental Health (NIMH). (2011). Use of mental health services and treatment among adults. Retrieved from www.nimh.nih.gov/statistics/3USE_MT_ADULT.shtml

Navaneelan, T., & Janz, T. (2014). Adjusting the scales: Obesity in the Canadian population after correcting for respondent bias. *Health at a Glance*. Statistics Canada Catalogue no. 82-624-X. Retrieved from www.statcan.gc.ca/pub/82-624-x/2014001/article/11922-eng.htm

Neergaard, L. (2018). AP-NORC poll: Edit baby genes for health, not smarts. Retrieved from www.apnews.com/ef1161deac194f2ca1fd99457dc2cf15

Neisser, U. (2000). Snapshots or benchmarks? In U. Neisser & I. Hyman (Eds.), *Memory observed: Remembering in natural contexts* (2nd ed., pp. 68–74). New York: Worth Publishing.

Neisser, U., & Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the news about *Challenger*. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies in flashbulb memories* (pp. 9–31). Cambridge, UK: Cambridge University Press.

Neisser, U., Boodoo, G., Bouchard, T. J., Boykin, A. W., Brody, N., ... Urbina, S. (1996). Intelligence: Knowns and unknowns. *American Psychologist*, *51*, 77–101.

Nenadic, I., Güllmar, D., Dietzek, M., Langbein, K., Steinke, J., & Gaser, C. (2015). Neuroimaging Brain structure in narcissistic personality disorder : A VBM and DTI pilot study. *Psychiatry Research*, *231*, 184–186.

Nesse, R., & Ellsworth, P. (2009). Evolution, emotions, and emotional disorders. *American Psychologist*, *64*, 129–139.

Nestler, E. J., & Hyman, S. E. (2010). Animal models of neuropsychiatric disorders. *Nature Neuroscience*, *13*, 1161–1169.

Neville, H. J. (1995). Developmental specificity in neurocognitive development in humans. In M. Gazzaniga (Ed.), *The cognitive neurosciences* (pp. 219–231). Cambridge, MA: MIT Press.

New, J., Krasnow, M. M., Truxaw, D., & Gaulin, S. J. C. (2007). Spatial adaptations for plant foraging: Women excel and calories count. *Proceedings of the Royal Society of London B.*, *274*, 2679–2684.

Newcombe, N. S., Drummey, A., Fox, N. A., et al. (2000). Remembering early childhood: How much, how, and why (or why not). *Current Directions in Psychological Science*, *9*, 55–58.

Newman, M. G., & Llera, S. J. (2011). A novel theory of experiential avoidance in generalized anxiety disorder: A review and synthesis of research supporting a contrast avoidance model of worry. *Clinical Psychology Review*, *31*, 371–382.

Newton, E. L. (1991). *The rocky road from actions to intentions* (published dissertation). Available from ProQuest Information and Learning.

Nibuya, M., Nestler, E. J., & Duman, R. S. (1996). Chronic antidepressant administration increases the expression of cAMP response element binding protein (CREB) in rat hippocampus. *Journal of Neuroscience*, *16*, 2365–2372.

Nicki, R. M., Gallagher, T. M., & Cormier, A. E. (2007). Attractiveness of video lottery terminal (VLT) games for problem and non-problem gamblers. *Gambling Research: Journal of the National Association for Gambling Studies (Australia)*, *19*, 21–35.

Nicoletti, A., Luca, A., Raciti, L., Contrafatto, D., Bruno, E., Dibilio, V., ... Zappia, M. (2013). Obsessive compulsive personality disorder and Parkinson's disease. *PLoS ONE*, *8*, e54822.

Nielsen, T. A., Laberge, L., Paquet, J., Tremblay, R. E., Vitaro, F., & Montplaisir, J. (2000). Development of disturbing dreams during adolescence and their relation to anxiety symptoms. *Sleep*, *23*, 1–10.

Nielsen, T. A., Stenstrom, P., & Levin, R. (2006). Nightmare frequency as a function of age, gender, and September 11, 2001: Findings from an internet questionnaire. *Dreaming*, *16*, 145–158.

Nielsen, T. A., Zadra, A. L., Simard, V., Saucier, S., Stentrom, P., Smith, C., & Kuiken, D. (2003). The typical dreams of Canadian university students. *Dreaming*, *13*, 211–235.

Nielsen Research. (2010, April 28). U.S. homes add even more TV sets in 2010. Retrieved from www.nielsen.com/us/en/newswire/2010/u-s-homes-add-even-more-tv-sets-in-2010.html

Nielson, K., Yee, D., & Erickson, K. (2005). Memory enhancement by a semantically unrelated emotional arousal source induced after learning. *Neurobiology of Learning and Memory*, *84*, 49–56.

Niogi, S. N., & Mukherjee, P. (2010). Diffusion tensor imaging of mild traumatic brain injury. *Journal of Head Trauma Rehabilitation*, *25*, 241–255.

Nisbet, E. K., & Gick, M. L. (2008). Can health psychology help the planet? Applying theory and models of health behaviour to environmental actions. *Canadian Psychology*, *49*, 296–303.

Nisbett, R. E. (2003). *The geography of thought: How Asians and Westerners think differently ... and why*. New York: Free Press.

Nisbett, R. E. (2005). Heredity, environment, and race differences in IQ: A commentary on Rushton and Jensen (2005). *Psychology, Public Policy, and Law*, *11*, 302–310.

Nisbett, R. E. (2009). *Intelligence and how to get it: Why schools and cultures count*. New York: Norton.

Nisbett, R. E., & Masuda, T. (2003). Culture and point of view. *Proceedings of the National Academy of Sciences*, *100*, 11163–11170.

Nisbett, R. E., & Wilson, T. D. (1977). Telling more than we can know: Verbal reports on mental processes. *Psychological Review*, *84*, 231.

Nisbett, R. E., Aronson, J., Blair, C., Dickens, W., Flynn, J., Halpern, D. F., & Turkheimer, E. (2012). Intelligence: New findings and theoretical developments. *American Psychologist*, *67*, 130–159.

Nisbett, R. E., Caputo, C., Legant, P., & Marecek, J. (1973). Behavior as seen by the actor and as seen by the observer. *Journal of Personality and Social Psychology*, *27*, 154–164.

Noels, K. A., Pelletier, L. G., Clement, R., & Vallerand, R. J. (2000). Why are you learning a second language? Motivational orientations and self-determination theory. *Language Learning*, *50*, 57–85.

Nolan, J. M., Schultz, P. W., Cialdini, R. B., Goldstein, N. J., & Griskevicius, V. (2008). Normative social influence is underdetected. *Personality and Social Psychology Bulletin*, *34*, 913–923.

Nolte, J. (1999). *The human brain* (4th ed.). St Louis: Mosby.

Norman, D., & Shallice, T. (1986). Attention to action. In R. J. Davidson, G. E. Schwartz, & D. Shapiro (Eds.), *Consciousness and self-regulation* (pp. 1–18). New York: Plenum Press.

Norman, G. R., Brooks, L. R., & Allen, S. W. (1989). Recall by expert medical practitioners and novices as a record of processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 1166–1174.

Norman, G. R., Rosenthal, D., Brooks, L. R., Allen, S. W., & Muzzin, L. J. (1989). The development of expertise in dermatology. *Archives of Dermatology*, *125*, 1063–1068.

Normile, D. (2018). For China, a CRISPR first goes too far. *Science*, *362*, 1091–1091.

Norr, A. M., Rizzo, A. A., Smolenski, D. J., Rothbaum, B. O., Reger, M. A., Katz, A. C., … D, P. K. P. (2018). Virtual reality exposure versus prolonged exposure for PTSD: Which treatment for whom? *Depression & Anxiety*, *35*, 523–529.

Norris, P., & Inglehart, R. (2019). *Cultural backlash*. Cambridge, UK: Cambridge University Press.

North, C. S., Ryall, J. E. M., Ricci, D. A., & Wetzel, R. D. (1993). *Multiple personalities, multiple disorders*. New York: Oxford University Press.

Northstone, K., Joinson, C., Emmett, P., Ness, A., & Paus, T. (2012). Are dietary patterns in childhood associated with IQ at 8 years of age? A population-based cohort study. *Journal of Epidemiology and Community Health*, *66*, 624–628.

Norton, A., Zipse, L., Marchina, S., & Schlaug, G. (2009). Melodic intonation therapy: Shared insights on how it is done and why it might help. *Annals of the New York Academy of Sciences*, *1169*, 431–436.

Nosek, B. A. (2007). Implicit–explicit relations. *Current Directions in Psychological Science*, *16*, 65–69.

Nosek, B. A., Banjai, M., & Greenwald, A. G. (2002). Harvesting implicit group attitudes and beliefs from a demonstration web site. *Group Dynamics: Theory, Research, and Practice*, *6*, 101–115.

Nosyk, B., Marshall, B. D. L., Fischer, B., Montaner, J. S. G., Wood, E., & Kerr, T. (2012). Increases in the availability of prescribed opioids in a Canadian setting. *Drug and Alcohol Dependence*, *126*, 7–12.

Nunn, J. A., Gregory, L. J., Brammer, M., Williams, S. C., Parslow, D. M., Morgan, M. J., et al. (2002). Functional magnetic resonance imaging of synesthesia: Activation of V4/V8 by spoken words. *Nature Neuroscience*, *5*, 371–375.

Nuytemans, K., Theuns, J., Cruts, M., & Van Broeckhoven, C. (2010). Genetic etiology of Parkinson disease associated with mutations in

the SNCA, PARK2, PINK1, PARK7, and LRRK2 genes: A mutation update. *Human Mutation*, *31*, 763–780.

Nyi, P. P., Lai, E. P., Lee, D. Y., Biglete, S. A., Torrecer, G. I., & Anderson, I. B. (2010). Influence of age on Salvia divinorum use: Results of an internet survey. *Journal of Psychoactive Drugs*, *42*, 385–392.

O'Brien, T. B., & DeLongis, A. (1996). The interactional context of problem-, emotion-, and relationship-focused coping: The role of the Big Five personality factors. *Journal of Personality*, *64*, 775–813.

O'Driscoll, C., Sener, S. B., Angmark, A., & Shaikh, M. (2019). Caregiving processes and expressed emotion in psychosis: a cross-cultural, meta-analytic review. *Schizophrenia Research*, *208*, 8–15.

O'Kearney, R., Gibson, M., Christensen, H., & Griffiths, K. M. (2006). Effects of a cognitive-behavioural Internet program on depression, vulnerability to depression and stigma in adolescent males: A school-based controlled trial. *Cognitive Behavior Therapy*, *35*, 43–54.

O'Keefe, D. J. (1999). Variability of persuasive message effects: Meta-analytic evidence and implications. *Document Design*, *1*, 87–97.

O'Keeffe, G. S., & Clarke-Pearson, K. (2011). The impact of social media on children, adolescents, and families. *Pediatrics*, *127*, 800–804.

O'Leary, C. M., Nassar, N., Kurinczuk, J. J., de Klerk, N., Geelhoed, E., ... Bower, C. (2010). Prenatal alcohol exposure and risk of birth

defects. *Pediatrics*, *126*, e843–e850.

O'Neill, L. K. (2010). Mental health support in northern communities: reviewing issues on isolated practice and secondary trauma. *Rural and Remote Health*, *10*, 1369.

O'Rahilly, R., & Mueller, F. (2008). Significant features in the early prenatal development of the human brain. *Annals of Anatomy*, *190*, 105–118.

Ochsner, K. N. (2000). Are affective events richly "remembered" or simply familiar? The experience and process of recognizing feelings past. *Journal of Experimental Psychology: General*, *129*, 242–261.

Ochsner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. *Trends in Cognitive Sciences*, *9*, 242–249.

Oehen, P., Traber, R., Widmer, V., & Schnyder, U. (2013). A randomized, controlled pilot study of MDMA (+/- 3,4-Methylenedioxymethamphetamine)-assisted psychotherapy for treatment of resistant, chronic post-traumatic stress disorder (PTSD). *Journal of Psychopharmacology*, *27*, 40–52.

Ogawa, S., Tank, D. W., Menon, R., Ellermann, J. M., Kim, S. G., ... Ugurbil, K. (1992). Intrinsic signal changes accompanying sensory stimulation: Functional brain mapping with magnetic resonance imaging. *Proceedings of the National Academy of Sciences of the United States of America*, *89*, 5951–5955.

Ogloff, J. R. P. (2006). Psychopathy/antisocial personality disorder conundrum. *Australian and New Zealand Journal of Psychiatry*, *40*, 519–528.

Öhman, A., & Mineka, S. (2001). Fears, phobias, and preparedness: Toward an evolved module of fear and fear learning. *Psychological Review*, *108*, 483–522.

Olds, J. (1958). Self-stimulation of the brain. *Science*, *127*, 315–324.

Olfson, M., & Marcus, S. C. (2009). National patterns in antidepressant medication treatment. *Archives of General Psychiatry*, *66*, 848–856.

Oliveira, T., Gouveia, M. J., & Oliveira, R. F. (2009). Testosterone responsiveness to winning and losing experiences in female soccer players. *Psychoneuroendocrinology*, *34*, 1056–1064.

Oliven, J. F. (1965). *Sexual hygiene and pathology*. Philadelphia: J. B. Lippincott Company.

Oliver, G., & Wardle, J. (1999). Perceived effects of stress on food choice. *Physiology and Behavior*, *66*, 511–515.

Oliveri, M., & Calvo, G. (2003). Increased visual cortical excitability in ecstasy users: A transcranial magnetic stimulation study. *Journal of Neurology, Neurosurgery, and Psychiatry*, *74*, 1136–1138.

Olshansky, S. J., Passaro, D. J., Hershow, R. C., Layden, J., Carnes, B. A., Brody, J., et al. (2005). A potential decline in life expectancy in the United States in the 21st century. *New England Journal of Medicine*, *352*, 1138–1145.

Olson, K. R., Lambert, A. J., & Zacks, J. M. (2004). Graded structure and the speed of category verification: On the moderating effects of anticipatory control for social vs. non-social categories. *Journal of Experimental Social Psychology*, *40*, 239–246.

Olson, M. A., & Fazio, R. H. (2001). Implicit attitude formation through classical conditioning. *Psychological Science*, *12*, 413–417.

Olsson, A., & Phelps, E. (2007). Social learning of fear. *Nature Neuroscience*, *10*, 1095–1102.

Olsson, A., Ebert, J. P., Banaji, M. R., & Phelps, E. A. (2005). The role of social groups in the persistence of learned fear. *Science*, *309*, 785–787.

Ontario Human Rights Commission. (2018). *A Collective Impact: Interim report on the inquiry into racial profiling and racial discrimination of Black persons by the Toronto Police Service*. Retrieved from http://ohrc.on.ca/en/public-interest-inquiry-racial-profiling-and-discrimination-toronto-police-service/collective-impact-interim-report-inquiry-racial-profiling-and-racial-discrimination-black

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science*, *349*, 943.

Opendak, M., Gould, E., & Sullivan, R. (2017). Early life adversity during the infant sensitive period for attachment: Programming of behavioral neurobiology of threat processing and social behavior. *Developmental Cognitive Neuroscience*, *25*, 145–159.

Opriş, D., Pintea, S., García-Palacios, A., Botella, C., Szamosköz, S,., & David, D. (2012). Virtual reality exposure therapy in anxiety disorders: A quantitative meta-analysis. *Depression and Anxiety*, *29*, 85–93.

Organ, A., & Fedoroff, J. P. (2015). Sexsomnia: Sleep sex research and its legal implications. *Current Psychiatry Reports*, *17*, 1–8.

Orne, M. T. (1962). On the social psychology of the pyschological experiment: With particular reference to demand characteristics and their implications. *American Psychologist*, *17*, 776–783.

Ostafin, B. D., Marlatt, G., & Greenwald, A. G. (2008). Drinking without thinking: An implicit measure of alcohol motivation predicts failure to control alcohol use. *Behaviour Research and Therapy*, *46*, 1210–1219.

Ot'alora G, M., Grigsby, J., Poulter, B., Van Derveer, J. W., Giron, S. G., Jerome, L., ... Doblin, R. (2018). 3,4-Methylenedioxymethamphetamine-assisted psychotherapy for treatment of chronic posttraumatic stress disorder: A randomized phase 2 controlled trial. *Journal of Psychopharmacology*, *32*, 1295–1307.

Overgaard, M., & Overgaard, R. (2011). Measurements of consciousness in the vegetative state. *The Lancet*, *378*, 2052–2054.

Overskeid, G., Grønnerød, & Simonton, D. K. (2012). The personality of a nonperson: Gauging the inner Skinner. *Perspectives on Psychological Science*, *7*, 187–197.

Owen, A. (2013). Detecting consciousness: A unique role for neuroimaging. *Annual Review of Psychology*, *64*, 109–133.

Owen, A. M., & Coleman, M. R. (2008). Functional neuroimaging of the vegetative state. *Nature Reviews Neuroscience*, *9*, 235–243.

Owen, A. M., Coleman, M. R., Boly, M., Davis, M. H., Laureys, S., & Pickard, J. D. (2006). Detecting awareness in the vegetative state. *Science*, *313*, 1402.

Owen, M. J., & O′Donovan, M. C. (2017). Schizophrenia and the neurodevelopmental continuum: Evidence from genomics. *World Psychiatry*, *16*, 227–235.

Owens, J. A., Dearth-Wesley, T., Lewin, D., Gioia, G., & Whitaker, R. C. (2016). Self-regulation and sleep duration, sleepiness, and chronotype in adolescents. *Pediatrics*, *138*, e20161406.

Oxford English Dictionary. (2011). Retrieved from http://dictionary.oed.com/entrance.dtl

Paller, K. (2004). Electrical signals of memory and of the awareness of remembering. *Current Directions in Psychological Science*, *13*, 49–55.

Pallesen, S., Hilde, I., Havik, O., & Nielsen, G. (2001). Clinical assessment and treatment of insomnia. *Professional Psychology: Research and Practice*, *32*, 115–124.

Pan, A., Malik, V. S., & Hu, F. B. (2012). Exporting diabetes mellitus to Asia: The impact of Western-style fast food. *Circulation*, *126*, 163–165.

Paparrigopoulos, T. J. (2005). REM sleep behaviour disorder: Clinical profiles and pathophysiology. *International Review of Psychiatry*, *17*, 293–300.

Papies, E. K., & Hamstra, P. (2010). Goal priming and eating behavior: Enhancing self-regulation by environmental cues. *Health Psychology*, *29*, 384–388.

Paquette, V., Levesque, J., Mensour, B., Leroux, J. M., Beaudoin, G., ... Beauregard, M. (2003). "Change the mind and you change the brain": Effects of cognitive-behavioral therapy on the neural correlates of spider phobia. *NeuroImage*, *18*, 401–409.

Paradis, C., Solomon, L. Z., Florer, F., & Thompson, T. (2004). Flashbulb memories of personal events of 9/11 and the day after for a sample of New York City residents. *Psychological Reports*, *95*, 304–310.

Paris, B. J. (1994). *Karen Horney: A psychoanalyst's search for self-understanding*. New Haven, CT: Yale University Press.

Park, D. C., & Huang, C-M. (2010). Culture wires the brain: A cognitive neuroscience perspective. *Perspectives on Psychological Science*, *5*, 391–400.

Park, S. S., & Rosén, L. A. (2013). The marital scales: measurement of intent, attitudes, and aspects regarding marital relationships. *Journal of Divorce and Remarriage*, *54*, 295–312.

Park, S., Püschel, J., Sauter, B. H., Rentsch, M., & Hell, D. (1999). Spatial working memory deficits and clinical symptoms of schizophrenia: A 4-month follow-up study. *Biological Psychiatry*, *46*, 392–400.

Parrott, M. D., & Greenwood, C. E. (2007). Dietary influences on cognitive function with aging. *Annals of the New York Academy of Sciences*, *1114*, 389–397.

Parsons, H. M. (1974). What happened at Hawthorne?: New evidence suggests the Hawthorne effect resulted from reinforcement contingencies. *Science*, *183*, 922–932.

Pascual-Leone, A., & Hamilton, R. (2001). The metamodal organization of the brain. *Progress in Brain Research*, *134*, 427–445.

Pascual-Leone, A., Amedi, A., Fregni, F., & Merabet, L. B. (2005). The plastic human brain cortex. *Annual Review of Neuroscience*, *29*, 377–

401.

Pasher, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, *9*, 105–119.

Pashler, H. (1998). *The psychology of attention*. Cambridge, MA: MIT Press.

Patrick, G. T. W., & Gilbert, J. A. (1896). Studies from the psychological laboratory of the University of Iowa: On the effects of loss of sleep. *Psychological Review*, *3*, 469–483.

Patrick, R. B., & Gibbs, J. C. (2012). Inductive discipline, parental expression of disappointed expectations, and moral identity in adolescence. *Journal of Youth and Adolescence*, *41*, 973–983.

Patterson, C. M., & Newman, J. P. (1993). Reflectivity and learning from aversive events: Toward a psychological mechanism for the syndromes of disinhibition. *Psychological Review*, *100*, 716–736.

Patterson, D., & Jensen, M. (2003). Hypnosis and clinical pain. *Psychological Bulletin*, *129*, 495–521.

Paul, D. B., & Blumenthal, A. L. (1989). On the trail of little Albert. *Psychological Record*, *39*, 547–553.

Paulesu, E., Frith, C., & Frackowiak, R. (1993). The neural correlates of the verbal component of working memory. *Nature*, *362*, 342–345.

Paulhus, D. L., & Williams, K. (2002). The dark triad of personality: Narcissism, Machiavellianism, and psychopathy. *Journal of Research in Personality*, *36*, 556–568.

Paz, R., & Paré, D. (2013). Physiological basis for emotional modulation of memory circuits by the amygdala. *Current Opinion in Neurobiology*, *23*, 381–386.

Peciña, M., Mickey, B. J., Wang, H., Langenecker, S. A., Hodgkinson, C., Shen, P. H., ... Zubieta, J. K. (2013). DRD2 polymorphisms module reward and emotion processing, dopamine neurotransmission and openness to experience. *Cortex*, *49*, 877–890.

Peeters, M., & Giuliano, F. (2007). Central neurophysiology and dopaminergic control of ejaculation. *Neuroscience and Biobehavioral Reviews*, *32*, 438–453.

Pelphrey, K. A., & Morris, J. P. (2006). Brain mechanisms for interpreting the actions of others from biological-motion cues. *Current Directions in Psychological Science*, *15*, 136–140.

Pemment, J. (2013). The neurobiology of antisocial personality disorder: The quest for rehabilitation and treatment. *Aggression and Violent Behavior*, *18*, 79–82.

Penfield, W., & Jasper, H. H. (1951). *Epilepsy and the functional anatomy of the human brain*. New York: Little, Brown, and Company.

Peng, S., Zhang, Y., Zhang, J., Wang, H., & Ren, B. (2011). Glutamate receptors and signal transduction in learning and memory. *Molecular Biology Reports*, *38*, 453–460.

Penn, D. L., & Combs, D. (2000). Modification of affect perception deficits in schizophrenia. *Schizophrenia Research*, *46*, 217–229.

Peralta, V., & Cuesta, M. J. (2011). Eugen Bleuler and the schizophrenias: 100 Years After. *Schizophrenia Bulletin*, *37*, 1118–1120.

Perciaccante, A., & Coralli, A. (2016). Franz Kafka's insomnia and parasomnias. *The Lancet Neurology*, *15*, 1014.

Pereira, E. A. C., Lu, G., Wang, S., Schweder, P. M., Hyam, J. A., ... Green, A. L. (2010). Ventral periaqueductal grey stimulation alters heart rate variability in humans with chronic pain. *Experimental Neurology*, *223*, 574–581.

Perini, F., Cattaneo, L., Carrasco, M., & Schwarzbach, J. V. (2012). Occipital transcranial magnetic stimulation has an activity-dependent suppressive effect. *Journal of Neuroscience*, *32*, 12361–12365.

Perloff, R. M. (2002). The third-person effect. In J. Bryant & D. Zillmann (Eds.), *Media effects: Advances in theory and research* (2nd ed., pp. 489–506). Mahwah, NJ: Erlbaum.

Perrin, J. S., Merz, S., Bennett, D. M., Currie, J., Steele, D. J., et al. (2012). Electroconvulsive therapy reduces frontal cortical connectivity in severe depressive disorder. *Proceedings of the National Academy of Sciences, USA*, *109*, 5464–5468.

Perry, J. L., & Carroll, M. E. (2008). The role of impulsive behavior in drug abuse. *Psychopharmacology*, *200*, 1–26.

Perry, W., Feifel, D., Minassian, A., Bhattacharjie, B. S., & Braff, D. L. (2002). Information processing deficits in acutely psychotic schizophrenia patients medicated and unmedicated at the time of admission. *American Journal of Psychiatry*, *159*, 1375–1381.

Pertea, M., & Salzberg, S. L. (2010). Between a chicken and a number of human genes. *Genome Biology*, *11*, 206.

Pertwee, R. G., & Ross, R. A. (2002). Cannabinoid receptors and their ligands. *Prostaglandins, Leukotrienes and Essential Fatty Acids*, *66*, 101–121.

Perunovic, W. Q. E., Heller, D., Ross, M., & Komar, S. (2011). The within-person dynamics of intrinsic and extrinsic motivation, affective states, and cultural identification: A diary study of bicultural individuals. *Social Psychology and Personality Science*, *2*, 635–641.

Peskin, M., Raine, A., Gao, Y., Venables, P. H., & Mednick, S. A. (2011). A developmental increase in allostatic load from ages 3 to 11 years is associated with increased schizotypal personality at age 23 years. *Developmental Psychopathology*, *23*, 1059–1068.

Pessoa, L., & Adolphs, R. (2010). Emotion processing and the amygdala: From a “low road” to “many roads” of evaluating biological significance. *Nature Reviews Neuroscience*, *11*, 773–783.

Pestian, J. P., Sorter, M., Connolly, B., McCullumsmith, C., Gee, T. J., ... Rohlfs, L. (2017). A machine learning approach to identifying the thought markers of suicidal subjects: A prospective multicenter trial. *Suicide and Life-Threatening Behavior, 47,* 112–121.

Peters, R. M., Hackeman, E., & Goldreich, D. (2009). Diminutive digits discern delicate details: Fingertip size and the sex difference in tactile spatial acuity. *The Journal of Neuroscience*, *29*, 15756–15761.

Peterson, C., Seligman, M. E. P., Yurko, K. H., Martin, L. R., & Friedman, H. S. (1998). Catastrophizing and untimely death. *Psychological Science*, *9*, 49–52.

Peterson, L., & Peterson, M. (1959). Short-term retention of individual verbal items. *Journal of Experimental Psychology*, *58*, 193–198.

Peterson, N. R., Pisoni, D. B., & Miyamoto, R. T. (2010). Cochlear implants and spoken language processing abilities: Review and assessment of the literature. *Restorative Neurology and Neuroscience*, *28*, 237–250.

Petrosino, A., Turpin-Petrosino, C., & Buehler, J. (2003). Scared Straight and other juvenile awareness programs for preventing juvenile delinquency: A systematic review of the randomized experimental

evidence. *Annals of the American Academy of Political and Social Science*, *589*, 41–62.

Petrovich, G. D., & Swanson, L. W. (1997). Projections from the lateral part of the central amygdalar nucleus to the postulated fear conditioning circuit. *Brain Research*, *763*, 247–254.

Pettigrew, T. F. (1997). Generalised intergroup contact effects on prejudice. *Personality and Social Psychology Bulletin*, *23*, 173–185.

Pettigrew, T. F. (1998). Intergroup contact theory. *Annual Review of Psychology*, *49*, 65–85.

Pettigrew, T. F., & Tropp, L. R. (2006). A meta-analytic test of intergroup contact theory. *Journal of Personality and Social Psychology*, *90*, 751.

Pew Research Center. (2018, October 11). The #MeToo hashtag has been used roughly 19 million times on Twitter in the past year, and usage often surges around news events. Retrieved from www.pewresearch.org/fact-tank/2018/10/11/how-social-media-users-have-discussed-sexual-harassment-since-metoo-went-viral/ft_18-10-11_metooanniversary_hashtag-used-19m_times/

Pfaus, J. G., & Scepkowski, L. A. (2005). The biologic basis for libido. *Current Sexual Health Reports*, *2*, 95–100.

Pfaus, J. G., Kippin, T. E., Coria-Avila, G. A., Gelez, H., Afonso, ... Parade, M. (2012). Who, what, where, when (and maybe even why)? How

the experience of sexual reward connects sexual desire, preference, and performance. *Archives of Sexual Behavior*, *41*, 31–62.

Pfefferbaum, A., Darley, C. F., Tinklenberg, J. R., Walton, R. T., & Kopell, B. S. (1977). Marijuana and memory intrusions. *Journal of Nervous & Mental Disease*, *165*, 165–172.

Pfundmair, M., & Wetherell, G. (2018). Ostracism drives group moralization and extreme group behavior. *The Journal of Social Psychology*, *159*, 518–530.

Phelps, E. A. (2004). Human emotion and memory: Interactions of the amygdala and hippocampal complex. *Current Opinion in Neurobiology*, *14*, 198–202.

Phelps, E. A., O'Connor, K. J., Cunningham, W. A., Funayama, S., Gatenby, J. C., ... Banaji, M. R. (2000). Performance on indirect measures of race evaluation predicts amygdala activation. *Journal of Cognitive Neuroscience 12*, 729–738.

Phillips-Silver, J. & Trainor, L. J. (2005). Feeling the beat in music: Movement influences rhythm perception in infants. *Science*, *308*, 1430.

Phillips, D. I. W. (2006). External influences on the fetus and their long-term consequences. *Lupus*, *15*, 794–800.

Phillips, M. L., & Swartz, H. A. (2014). A critical appraisal of neuroimaging studies of bipolar disorder: Toward a new conceptualization of underlying neural circuitry and a road map for future research. *American Journal of Psychiatry*, *171*, 829–843.

Phillips, M. L., Bullmore, E. T., Howard, R., Woodruff, P. W., Wright, I. C., ... David, A. S. (1998). Investigation of facial recognition memory and happy and sad facial expression perception: An fMRI study. *Psychiatry Research*, *83*, 127–138.

Phillips, M., Brooks-Gunn, J., Duncan, G. J., Klebanov, P. K., & Crane, J. (1998). Family background, parenting practices, and the Black–White test score gap. In C. Jencks & M. Phillips (Eds.), *The Black–White test score gap* (pp. 102–145). Washington, DC: Brookings Institution Press.

Phillips, R. G., & LeDoux, J. E. (1992). Differential contribution of amygdala and hippocampus to cued and contextual fear conditioning. *Behavioral Neuroscience*, *106*, 274–285.

Piaget, J., & Inhelder, B. (1956). *The child's conception of space*. Boston: Routledge & Kegan Paul.

Pianezza, M. L., Sellers, E. M., & Tyndale, R. F. (1998). Nicotine metabolism defect reduces smoking. *Nature*, *393*, 750.

Pica, P., Jackson, S., Blake, R., & Troje, N. F. (2011). Comparing biological motion perception in two distinct human societies. *PLoS One*, *6*, e28391.

Piet, J., Hougaard, E., Hecksher, M. S., & Rosenberg, N. K. (2010). A randomized pilot study of mindfulness-based cognitive therapy and group cognitive-behavioral therapy for young adults with social phobia. *Scandinavian Journal of Psychology*, *51*, 403–410.

Pilley, J. W., & Reid, A. K. (2011). Border collie comprehends object names as verbal referents. *Behavioural Processes*, *86*, 184–195.

Pillinger, T., D'Ambrosio, E., McCutcheon, R., & Howes, O. D. (2019). Is psychosis a multisystem disorder? A meta-review of central nervous system, immune, cardiometabolic, and endocrine alterations in first-episode psychosis and perspective on potential models. *Molecular Psychiatry*, *24*, 776–794.

Pinker, S. (1994). *The language instinct*. New York: William Morrow.

Pinker, S. (1999). *Words and rules: The ingredients of language*. New York: Basic Books.

Pinsker, H., Kupfermann, I., Castellucci, V., & Kandel, E. (1970). Habituation and dishabituation of the gill-withdrawal reflex in *Aplysia*. *Science*, *167*, 1740–1742.

Pinto, A., Mancebo, M., Eisen, J., Pagano, M., & Rasmussen, S. (2006). The Brown longitudinal obsessive compulsive study: Clinical features and symptoms of the sample at intake. *Journal of Clinical Psychiatry*, *67*, 703–711.

Pizzagalli, D. A., Lehmann, D., Hendrick, A. M., Regard, M., Pascual-Marqui, R. D., & Davidson, R. J. (2002). Affective judgments of faces modulate early activity (~160 ms) within the fusiform gyri. *NeuroImage*, *16*, 663–677.

Plant, E. A., & Peruche, B. (2005). The consequences of race for police officers' responses to criminal suspects. *Psychological Science*, *16*, 180–183.

Plomin, R., & Caspi, A. (1999). Behavioral genetics and personality. In L. A. Pervin & O. P. John (Eds.), *Handbook of personality: Theory and research* (2nd ed., pp. 251–276). New York: Guilford Press.

Plomin, R., & Crabbe, J. (2000). DNA. *Psychological Bulletin*, *126*, 806–828.

Plomin, R., & Spinath, F. M. (2004). Intelligence: Genetics, genes, and genomics. *Journal of Personality and Social Psychology*, *86*, 112–129.

Plomin, R., Corley, R., DeFries, J. C., & Fulker, D. W. (1997). Nature, nurture, and cognitive development from 1 to 16 years: A parent–offspring adoption study. *Psychological Science*, *8*, 442–447.

Poeppl, T. B., Langguth, B., Rupprecht, R., Laird, A. R., & Eickhoff, S. B. (2016). A neural circuit encoding sexual preference in humans. *Neuroscience and Biobehavioral Reviews*, *68*, 530–536.

Polansky, J. (2016). 2015 numbers: After rebound, film smoking falls to near lows. *Smoke Free Movies*. Retrieved from http://smokefreemovies.ucsf.edu/blog/2015-numbers-after-rebound-film-smoking-falls-near-lows

Polansky, J. R., Titus, K., Lanning, N., & Glantz, S. A. (2013). *Smoking in top-grossing US movies, 2012*. San Francisco: Center for Tobacco Control Research and Education.

Polivy, J., & Herman, C. P. (2002). Causes of eating disorders. *Annual Review of Psychology*, *53*, 187–213.

Polivy, J., Herman, C. P., & Coelho, J. S. (2008). Caloric restriction in the presence of attractive food cues: External cues, eating, and weight. *Physiology & Behavior*, *94*, 729–733.

Pollack, D., McFarland, B., Mahler, J., & Kovas, A. (2005). Outcomes of patients in a low-intensity, short-duration involuntary outpatient commitment program. *Psychiatric Services*, *56*, 863–866.

Polymeropoulos, M. H., Lavedan, C., Leroy, E., Ide, S. E., Dehejia, A., Dutra, A., ... Nussbaum, R. L. (1997). Mutation in the alpha-synuclein gene identified in families with Parkinson's disease. *Science*, *276*, 2045–2047.

Ponder, C. A., Kliethermes, C. L., Drew, M. R., Muller, J. J., Das, K. K, ... Palmer, A. A. (2007). Selection for contextual fear conditioning affects anxiety-like behaviors and gene expression. *Genes, Brain & Behavior*, *6*, 736–749.

Pope, H. G., Gruber, A. J., Hudson, J. I., Cohane, G., Huetis, M. A., & Yurgelun-Todd, D. (2003). Early-onset cannabis use and cognitive deficits: What is the nature of the association? *Drug and Alcohol Dependence*, *69*, 303–310.

Popova, S., Lange, S., Probst, C., Gmel, G, & Rehm, J. (2017). Estimation of national, regional, and global prevalence of alcohol use during pregnancy and fetal alcohol syndrome: A systematic review and meta-analysis. *The Lancet Global Health*, *5*, e290–99.

Porter, R. H., & Winberg, J. (1999). Unique salience of maternal breast odors for newborn infants. *Neuroscience and Biobehavioral Reviews*, *23*, 439–449.

Porter, S., ten Brinke, L., & Gustaw, C. (2010). Dangerous decisions: The impact of first impressions of trustworthiness on the evaluation of legal evidence and defendant culpability. *Psychology, Crime & Law*, *16*, 1–15.

Poulin-Dubois, D., Blaye, A., Coutya, J., & Bialystok, E. (2011). The effects of bilingualism on toddlers' executive functioning. *Journal of Experimental Child Psychology*, *108*, 567–579.

Pound, P., Denford, S., Shucksmith, J., Tanton, C., Johnson, A. M., ... Campbell, R. (2017). What is best practice in sex and relationship education? A synthesis of evidence, including stakeholders' views. *British Medical Journal*, *7*, 1–11.

Powell, J. L. (2012). Why climate deniers have no scientific credibility—in one pie chart. *Desmog*. Retrieved from www.desmogblog.com/2012/11/15/why-climate-deniers-have-no-credibility-science-one-pie-chart

Powers, M. B., & Emmelkamp, P. M. G. (2008). Virtual reality exposure therapy for anxiety disorders: A meta-analysis. *Journal of Anxiety Disorders 39*, 250–261.

Prause, N., & Pfaus, J. (2015). Viewing sexual stimuli associated with greater sexual responsiveness, not erectile dysfunction. *Sexual Medicine*, *3*, 90–98.

Prentice, D. A., & Miller, D. T. (1993). Pluralistic ignorance and alcohol use on campus: Some consequences of misperceiving the social norm. *Journal of Personality and Social Psychology*, *64*, 243.

Price, E. L., McLeod, P. J., Gleich, S. S., & Hand, D. (2006). One-year prevalence rates of major depressive disorder in first-year university students. *Canadian Journal of Counselling*, *40*, 68–81.

Price, J. (2008). Parent-child quality time: Does birth order matter? *Journal of Human Resources*, *43*, 240–265.

Price, J. S., McQueeny, T., Shollenbarger, S., Browning, E. L., Wieser, J., & Lisdahl, K. M. (2015). Effects of marijuana use on prefrontal and parietal volumes and cognition in emerging adults. *Psychopharmacology*, *232*, 2929–2950.

Primack, B. A., Bisbey, M. A., Shensa, A., Bowman, N. D., Karim, S. A., Knight, J. M., & Sidani, J. E. (2018). The association between valence of social media experiences and depressive symptoms. *Depression & Anxiety*, *35*, 784–794.

Prochaska, J. O., & Norcross, J. C. (2002). Stage of change. In J. C. Norcross (Ed.), *Psychotherapy relationships that work* (pp. 303–313). New York: Oxford.

Proudfoot, J., Ryden, C., Everitt, B., Shapiro, D. A., Goldberg, D., ... Gray, J. A. (2004). Clinical efficacy of computerised cognitive-behavioural therapy for anxiety and depression in primary care: Randomised controlled trial. *British Journal of Psychiatry*, *185*, 46–54.

Public Health Agency of Canada. (2013). Leading causes of death, Canada, 2008. Retrieved from www.phac-aspc.gc.ca/publicat/lcd-pcd97/pdf/lcd-pcd-t1-eng.pdf

Public Health Agency of Canada. (2018). Measles: For health professionals. Retrieved from: www.canada.ca/en/public-health/services/diseases/measles/health-professionals-measles.html

Public Prosecution Service of Canada. (2011). *Report of the federal/provincial/territorial heads of prosecutions subcommittee on the prevention of wrongful convictions*. Retrieved from www.ppsc-sppc.gc.ca/eng/pub/ptj-spj/index.html

Pujol, J., Soriano-Mas, C., Ortiz, H., Sebastian-Galles, N., Losilla, J. M., & Deus, J. (2006). Myelination of language-related areas in the developing brain. *Neurology*, *66*, 339–343.

Pulvers, K., & Hood, A. (2013). The role of positive traits in pain catastrophizing in pain perception. *Current Pain and Headache Reports*, *17*, 330.

Putnam, F. W. (1989). *Diagnosis and treatment of multiple personality disorder*. New York: Guilford Press.

Qu, S., Olafsrud, S. M., Meza-Zepeda, L. A., & Saatcioglu, F. (2013). Rapid gene expression changes in peripheral blood lymphocytes upon practice of a comprehensive yoga program. *PLoS One*, *8*, 1–8.

Quirk, G. J., & Beer, J. S. (2006). Prefrontal involvement in the regulation of emotion: Convergence of rat and human studies. *Current Opinion in Neurobiology*, *16*, 723–727.

Quirk, G. J., & Mueller, D. (2008). Neural mechanisms of extinction learning and retrieval. *Neuropsychopharmacology*, *33*, 56–72.

Rada, P., Avena, N. M., & Hoebel, B. G. (2005). Daily bingeing on sugar repeatedly releases dopamine in the accumbens shell. *Neuroscience*, *134*, 737–744.

Radesky, J. S., Schumacher, J., & Zuckerman, B. (2015). Mobile and interactive media use by young children: The good, the bad, and

the unknown. *Pediatrics*, *135*, 1–3.

Radke, S., Volman, I., Kokal, I., Roelofs, K., de Bruijn, E.R.A., & Toni, I. (2017). Oxytocin reduces amygdala responses during threat approach. *Psychoneuroendocrinology*, *79*, 160–166.

Raffi, A. R., Rondini, M., Grandi, S., & Fava, G. A. (2000). Life events and prodromal symptoms in bulimia nervosa. *Psychological Medicine*, *30*, 727–731.

Raichle, M. E. (2015). The brain's default mode network. *Annual Review of Neuroscience*, *38*, 433–447.

Raichle, M. E., MacLeod, A. M., Snyder, A. Z., Powers, W. J., Gusnard, D. A., & Shulman, G. L. (2001). A default mode of brain function. *Proceedings of the National Academy of Sciences USA*, *98*, 676–682.

Raichlen, D. A., & Alexander, G. E. (2017). Adaptive capacity: An evolutionary neuroscience model linking exercise, cognition, and brain health. *Trends in Neuroscience*, *40*, 408–421.

Raison, C. L., Capuron, L., & Miller, H. (2006). Cytokines sing the blues: Inflammation and the pathogenesis of depression. *Trends in Immunology*, *27*, 24–31.

Ramachandran, V. S., & Altschuler, E. L. (2009). The use of visual feedback, in particular mirrorvisual feedback, in restoring brain function. *Brain*, *132*, 1693–1710.

Ramachandran, V. S., & Gregory, R. L. (1991). Perceptual filling in of artificially induced scotomas in human vision. *Nature*, *350*, 699–702.

Ramachandran, V. S., & Hubbard, E. M. (2003). The phenomenology of synaesthesia. *Journal of Consciousness Studies*, *10*, 49–57.

Ranehill, E., Dreber, A., Johannesson, M., Leiberg, S., Sunhae, S., & Weber, R. A. (2015). Assessing the robustness of power posing: No effect on hormones and risk tolerance in a large sample of men and women. *Psychological Science*, *26*, 1– 4.

Ranganath, C., Johnson, M. K., & D′Esposito, M. (2003). Prefrontal activity associated with working memory and episodic long-term memory. *Neuropsychologia*, *41*, 378–389.

Ranganathan, M., & D′Souza, D. C. (2006). The acute effects of cannabinoids on memory in humans: A review. *Psychopharmacology*, *188*, 425–444.

Rasmussen, E. B., & Newland, M. C. (2008). Asymmetry of reinforcement and punishment in human choice. *Journal of the Experimental Analysis of Behavior*, *89*, 157–167.

Rauscher, F. H., Shaw, G. L., & Ky, K. N. (1993). Music and spatial task performance. *Nature*, *365*, 611.

Rauthman, J. F., Sherman, R. A., & Funder, D. C. (2015), Principles of situation research: Towards a better understanding of psychological situations. *European Journal of Personality*, *29*, 363–381.

Ravindran, A. V., Balneaves, L. G., Faulkner, G., Ortiz, A., McIntosh, D., ... the CANMAT Depression Work Group (2016). Canadian Network for Mood and Anxiety Treatments (CANMAT) 2016 clinical guidelines for the management of adults with major depressive disorder: Section 5. Complementary and alternative treatments. *Canadian Journal of Psychiatry*, *61*, 576–587.

Raynor, H. A., & Epstein, L. (2003). The relative-reinforcing value of food under differing levels of food deprivation and restriction. *Appetite*, *40*, 15–24.

Raz, A., Fan, J., & Posner, M. I. (2005). Hypnotic suggestion reduces conflict in the human brain. *Proceedings of the National Academy of Sciences*, *102*, 9978–9983.

Raz, N. (2000). Aging of the brain and its impact on cognitive performance: Integration of structural and functional findings. In F. I. M. Craik & T. A. Salthouse (Eds.), *Handbook of aging and cognition —II*. (pp. 1–90). Mahwah, NJ: Lawrence Erlbaum Associates.

Razzini, C., Bianchi, F., Leo, R., Fortuna, E., Siracusano, A., & Romeo, F. (2008). Correlations between personality factors and coronary artery disease: From type A behaviour pattern to type D personality. *Journal of Cardiovascular Medicine*, *9*, 761–768.

Rechtschaffen, A. (1998). Current perspectives on the function of sleep. *Perspectives in Biological Medicine*, *41*, 359–390.

Reed, T. E., Vernon, P. A., & Johnson, A. M. (2004). Confirmation of correlation between brain nerve conduction velocity and intelligence level in normal adults. *Intelligence*, *32*, 563–572.

Regan, B. C., Julliot, C., Simmen, B., Vienot, F., Charles-Dominique, P., & Mollon, J. D. (2001). Fruits, foliage and the evolution of primate colour vision. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *356*, 229–283.

Rehm, J., Baliunas, D., Brochu, S., Fischer, B., Gnam, W., Patra, J., et al. (2006). *The costs of substance abuse in Canada 2002*. Ottawa: Canadian Centre on Substance Abuse.

Reichert, T., Heckler, S. E., & Jackson, S. (2001). The effects of sexual social marketing appeals on cognitive processing and persuasion. *Journal of Advertising*, *30*, 13–27.

Reinders, A. T. S., Nijenhuis, E. R. S., Paans, A. M. J., Korf, J., Willemsen, A. T. M., & den Boer, J. A. (2003). One brain, two selves. *NeuroImage*, *20*, 2119–2125.

Reingen, P. H., & Kernan, J. B. (1993). Social perception and interpersonal influence: Some consequences of the physical attractiveness stereotype in a personal selling setting. *Journal of Consumer Psychology*, *2*, 25–38.

Reiter, E. O., & Lee, P. A. (2001). Have the onset and tempo of puberty changed? *Archives of Pediatrics & Adolescent Medicine*, *155*, 988–989.

Rendell, L., & Whitehead, H. (2001). Culture in whales and dolphins. *Behavioral and Brain Sciences*, *24*, 309–382.

Renner, M., & Mackin, R. (1998). A life stress instrument for classroom use. *Teaching of Psychology*, *25*, 46–48.

Rensink, R. A., O'Regan, J. K., & Clark J. J. (2000). On the failure to detect changes in scenes across brief interruptions. *Visual Cognition*, *7*, 127–145.

Rensink, R. A., O'Regan, J. K., & Clark, J. J. (1997). To see or not to see: The need for attention to perceive changes in scenes. *Psychological Science*, *8*, 368–373.

Rentfrow, P. J., & Jokela, M. (2016). Geographical psychology: The spatial organization of psychological phenomena. *Current Directions in Psychological Science*, *25*, 393–398.

Reuter, M.S., Riess, A., Moog, U., Briggs, T.A., ... Zweier, C. (2017). FOXP2 variants in 14 individuals with developmental speech and language disorders broaden the mutational and clinical spectrum. *Journal of Medical Genetics*, *54*, 64–72.

Rhodes, G. (2006). The evolutionary psychology of facial beauty. *Annual Review of Psychology*, *57*, 199–226.

Ricciardelli, L. A., & McCabe, M. P. (2004). A biopsychosocial model of disordered eating and the pursuit of muscularity in adolescent boys. *Psychological Bulletin*, *130*, 179–205.

Richardson, K., & Norgate, S. H. (2015). Does IQ really predict job performance? *Applied Developmental Science*, *19*(3), 153–169.

Richardson, P. J., & Boyd, R. (2005). *Not by genes alone: How culture transformed human evolution*. Chicago: University of Chicago Press.

Richdale, J. (Writer), & Kirland, M. (Director). (1994). Burns' Heir [Television series episode]. In J. L. Brooks & M. Groening (Producers), *The Simpsons*. Los Angeles, CA: 20th Century Fox Television.

Richmond, D., & Hartman, P. T. (1982). Sex appeal in advertising. *Journal of Advertising Research*, *22*, 53–61.

Rideout, V., & Hamel, E. (2006). *The media family: Electronic media in the lives of infants, toddlers, preschoolers, and their parents*. Menlo Park, CA: Henry J. Kaiser Foundation.

Ridout, B., & Campbell, A. (2014). Using Facebook to deliver a social norm intervention to reduce problem drinking at university. *Drug and Alcohol Review*, *33*, 667–673.

Rieber, R., & Robinson, D. (Eds.). (1980). *Wilhelm Wundt and the making of a scientific psychology*. New York: Kluwer Academic/Plenum

Publishers.

Rieger, G., & Savin-Williams, R. C. (2012). Gender nonconformity, sexual orientation, and psychological well-being. *Archives of Sexual Behavior*, *41*, 611–621.

Rifkin, A., Ghisalbert, D., Dimatou, S., Jin, C., & Sethi, M. (1998). Dissociative identity disorder in psychiatric inpatients. *American Journal of Psychiatry*, *155*, 844–845.

Riggle, E. D. B., Rostosky, S. S., & Horne, S. G. (2010). Psychological distress, well-being, and legal recognition in same-sex couple relationships. *Journal of Family Psychology*, *24*, 82–86.

Righ-Najarian, L. (2013). Personality disorders in the media. *Psychology in Action*. Retrieved from www.psychologyinaction.org/psychology-in-action-1/2013/10/31/personality-disorders-in-the-media

Riper, H., Hoogendoorn, A., Cuijpers, P., Karyotaki, E., Boumparis, N., Mira, A. et al. (2018). Effectiveness and treatment moderators of internet interventions for adult problem drinking: An individual patient data meta-analysis of 19 randomised controlled trials. *PLoS Medicine*, *15*, e1002714.

Ripke, S., O'Dushlaine, C., Chambert, K., Moran, J. L., Kähler, A. K., … Sullivan, P. F. (2013). Genome-wide association analysis identifies 13 new risk loci for schizophrenia. *Nature Genetics*, *45*, 1150–1159.

Risko, E. F., Anderson, N., Sarwal, A., Engelhardt, M., & Kingstone, A. (2012). Everyday attention: Variation in mind wandering and memory in a lecture. *Applied Cognitive Psychology*, *26*, 234–242.

Ritterband, L., Thorndike, F., Gonder-Frederick, L., Magee, J., Bailey, E., Saylor, D., et al. (2009). Efficacy of an internet-based behavioral intervention for adults with insomnia. *Archives of General Psychiatry*, *66*, 692–698.

Riva, G. (2005). Virtual reality in psychotherapy: Review. *CyberPsychology & Behavior*, *8*, 220–240.

Riva, G., Baños, R. M., Botella, C., Mantovani, F., & Gaggioli, A. (2016). Transforming experience: The potential of augmented reality and virtual reality for enhancing personal and clinical change. *Frontiers in Psychiatry*, *7*, article 164.

Rivera, S. M., Wakeley, A., & Langer, J. (1999). The drawbridge phenomenon: Representational reasoning or perceptual preference. *Developmental Psychology*, *35*, 427–435.

Riveros-McKay, F., Mistry, V., Bounds, R., Hendricks, A., Keogh, J. M., ... Farooqi, I. S. (2019). Genetic architecture of human thinness compared to severe obesity. *PLoS Genetics*, *15*, e1007603.

Rizzo, A. S., Difede, J., Rothbaum, B. O., Reger, G., Spitalnick, J., ... McLay, R. (2010). Development and early evaluation of the virtual Iraq/Afghanistan exposure therapy system for combat-related PTSD. *Annals of the New York Academie of Sciences*, *1208*, 114–125.

Rizzolatti, G., & Craighero, L. (2004). The mirror-neuron system. *Annual Review of Neuroscience*, *27*, 169–192.

Rizzolatti, G., Fadiga, L., Fogassi, L., & Gallese, V. (1996). Premotor cortex and the recognition of motor actions. *Cognitive Brain Research*, *3*, 131–141.

Robbins, T. W. (2000). Chemical neuromodulation of frontal-executive functions in humans and other animals. *Experimental Brain Research*, *133*, 130–138.

Robbins, T. W., Jones, G. H., & Wilkinson, L. S. (1996). Behavioural and neurochemical effects of early social deprivation in the rat. *Journal of Psychopharmacology*, *10*, 39–47.

Roberts, B., Walton, K., & Viechtbauer, W. (2006). Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. *Psychological Bulletin*, *132*, 1–25.

Roberts, C. A., Quednow, B. B., Montgomery, C., & Parrott, A. C. (2018). MDMA and brain activity during neurocognitive performance: An overview of neuroimaging studies with abstinent 'Ecstasy' users. *Neuroscience and Biobehavioral Reviews*, *84*, 470–482.

Roberts, C. A., Wetherell, M. A., Fisk, J. E., & Montgomery, C. A. (2015). Differences in prefrontal blood oxygenation during an acute multitasking stressor in escstasy polydrug users. *Psychological Medicine*, *45*, 395–406.

Roberts, G., & Grimes, K. (2011). *Return on investment: Mental health promotion and mental illness prevention. A Canadian Policy Network / Canadian Institute for Health Information report*. Ottawa: CIHI.

Roberts, P. M., Garcia, L. J., Desrochers, A., & Hernandez, D. (2002). English performance of proficient bilingual adults on the Boston Naming Test. *Aphasiology*, *16*, 635–645.

Roberts, R., Roberts, C., & Duong, H. (2009). Sleepless in adolescence: Prospective data on sleep deprivation, health and functioning. *Journal of Adolescence*, *32*, 1045– 1057.

Robertson, S. I. (2001). *Problem solving*. New York: Psychology Press.

Robinson, O. J., Cools, R., Carlisi, C. O., Sahakian, B. J., & Drevets, W. C. (2011). Ventral striatum response during reward and punishment reversal learning in unmedicated major depressive disorder. *American Journal of Psychiatry*, *169*, 152–159.

Robinson, P. N., Krawitz, P., & Mundlos, S. (2011). Strategies for exome and genome sequence data analysis in disease-gene discovery projects. *Clinical Genetics*, *80*, 127–132.

Robleto, K., Poulos, A. M, & Thompson, R. F. (2004). Brain mechanisms of extinction of the classically conditioned eyeblink response. *Learning & Memory*, *11*, 517–524.

Rocca, M. A., Valsasina, P., Absinta, M., Riccitelli, G., Rodegher, M. E., ... Filippi, M. (2010). Default-mode network dysfunction and cognitive impairment in progressive MS. *Neurology*, *74*, 1252–1259.

Rocca, M. A., Valsasina, P., Martinelli, V., Misci, P., Falini, A., ... Filippi, M. (2012). Large-scale neuronal network dysfunction in relapsing-remitting multiple sclerosis. *Neurology*, *79*, 1449–1457.

Rochlen, A., McKelley, R., & Pituch, K. (2006). A preliminary examination of the "Real Men. Real Depression" campaign. *Psychology of Men & Masculinity*, *7*, 1–13.

Roe, D., & Finger, S. (1996). Gustave Dax and his fight for recognition: An overlooked chapter in the early history of cerebral dominance. *Journal of the History of the Neurosciences*, *5*, 228–240.

Roediger, H. L., & McDermott, K. B. (1995). Creating false memories: Remembering words not presented in lists. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *21*, 803–814.

Roediger, H., Agarwal, P. K., Kang, S. K., & Marsh, E. J. (2010). Benefits of testing memory: Best practices and boundary conditions. In G. M. Davies & D. B. Wright (Eds.), *Current issues in applied memory research* (pp. 13–49). New York: Psychology Press.

Rogers, C. (1951). *Client-centered therapy: Its current practice, implications and theory*. London: Constable.

Rogers, J., Kochunov, P., Zilles, K., Shelledy, W., Lancaster, J., Thompson, P., ... Glahn, D. D. (2010). On the genetic architecture of cortical folding and brain volume in primates. *NeuroImage*, *53*, 1103–1108.

Rogoff, B., Mistry, J., Goncu, A., & Mosier, C. (1993). Guided participation in cultural activity by toddles and caregivers. *Monographs for the Society of Research in Child Development*, 58 (serial no. 236).

Rollins, B. C. (1989). Marital quality at midlife. In S. Hunter & M. Sundel (Eds.), *Midlife myths* (pp. 184–194). Newbury Park, CA: Sage.

Rolls, E. T. (2010). Neural representation of fat texture in the mouth. In J-P. Montmayeur & J. le Coutre (Eds.), *Fat detection: Taste, texture, and post ingestive effects* (pp. 197–223). Boca Raton, FL: CRC Press.

Romer, D., Duckworth, A. L., Sznitman, S., & Park, S. (2010). Can adolescents learn self-control? Delay of gratification in the development of control over risk taking. *Prevention Science*, *11*, 319–330.

Romer, D., Reyna, V. F., & Satterthwaite, T. D. (2017). Beyond stereotypes of adolescent risk taking: Placing the adolescent brain in developmental context. *Developmental Cognitive Neuroscience*, *27*, 19–34.

Rorty, M., Yager, J., Rossotto, E., & Buckwalter, G. (2000). Parental intrusiveness in adolescence recalled by women with a history of

bulimia nervosa and comparison women. *International Journal of Eating Disorders*, *28*, 202–208.

Rosch, E., & Mervis, C. B. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology*, *7*, 573–605.

Rosch, E., Mervis, C. B., Gray, W., Johnson, D., & Boyes-Braem, P. (1976). Basic objects in natural categories. *Cognitive Psychology*, *8*, 382–439.

Rose, D., Wykes, T., Leese, M., Bindman, J., & Fleischmann, P. (2003). Patients′ perspectives on electroconvulsive therapy: Systematic review. *British Medical Journal*, *326*, 1363–1368.

Rose, N., Myerson, J., Roediger, H., & Hale, S. (2010). Similarities and differences between working memory and long-term memory: Evidence from the levels-of-processing span task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *36*, 471–483.

Rosell, D. R., Futterman, S. E., McMaster, A., & Siever, L. J. (2015). Schizotypal personality disorder: A current review. *Current Psychiatry Reports*, *16*, 452.

Roselli, C. E. (2017). Neurobiology of gender identity and sexual orientation. *Journal of Neuroendocrinology*, *30*, e12562.

Roselli, C. E., Larkin, K., Schrunk, J. M., & Stormshak, F. (2004). Sexual partner preference, hypothalamic morphology and aromatase in rams. *Physiology and Behavior*, *83*, 233–245.

Rosenbaum, R. S., Kohler, S., Schacter, D. L., Moscovitch, M., Westmacott, R., Black, S. E., et al. (2005). The case of K.C.: Contributions of a memory-impaired person to memory theory. *Neuropsychologia*, *43*, 989–1021.

Rosenblum, G. D., & Lewis, M. (2003). Emotional development in adolescence. In G. D. Rosenblum & M. Lewis (Eds.), *Blackwell handbook of adolescence* (pp. 269–289). Malden, MA: Blackwell Publishing.

Rosenfield, S. (1997). Labeling mental illness: The effects of received services and perceived stigma on life satisfaction. *American Sociological Review*, *62*, 660–672.

Rosenhan, D. L. (1973). On being sane in insane places. *Science*, *179*, 250–258.

Rosenthal, R. (1974). *On the social psychology of the self-fulfilling prophecy: Further evidence for Pygmalion effects and their mediating mechanisms*. New York: MSS Modular Publications.

Rosenthal, R., & Fode, K. L. (1963). The effect of experimenter bias on the performance of the albino rat. *Behavioral Science*, *8*, 183–189.

Rosenthal, R., & Jacobson, L. (1966). Teachers' expectancies: Determinates of pupils' IQ gains. *Psychological Reports*, *19*, 115–118.

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the classroom: Teacher expectation and pupils' intellectual development*. New York: Holt, Rinehart & Winston.

Rosenzweig, M. R., Krech, D., Bennett, E. L., & Diamond, M. C. (1962). Effects of environmental complexity and training on brain chemistry and anatomy: A replication and extension. *Journal of Comparative and Physiological Psychology*, *55*, 429–437.

Ross, C. E., Mirowsky, J., & Goldsteen, K. (1990). The impact of the family on health: The decade in review. *Journal of Marriage and the Family*, *52*, 1059–1078.

Ross, L. (1977). The intuitive psychologist and his shortcomings: Distortions in the attribution process. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 10). New York: Academic Press.

Ross, L. A., Webb, C. E., Whitaker, C., Hicks, J. M., Schmidt, E. L., ... Visscher, K. M. (2018). The effects of useful field of view training on brain activity and connectivity. *Journal of Gerontology B Psychological Sciences and Social Sciences*, gby041.

Ross, L., & Ward, A. (1996). Naive realism in everyday life: Implications for social conflict and misunderstanding. In T. Brown, E. S. Reed, &

E. Turiel (Eds.), *Values and knowledge* (pp. 103–135). Hillsdale, NJ: Erlbaum.

Ross, M., & Wang, Q. (2010). Why we remember and what we remember: Culture and autobiographical memory. *Perspectives on Psychological Science*, *5*, 401–409.

Ross, M., & Wilson, A. E. (2000). Constructing and appraising past selves. In D. L. Schacter & E. Scarry (Eds.), *Memory, brain and belief* (pp. 231–258). Cambridge, MA: Harvard University Press.

Rosselli, M., Ardila, A., Araujo, K., Weekes, V. A., Caracciolo, V., Padilla, M., et al. (2000). Verbal fluency and repetition skills in healthy older Spanish–English bilinguals. *Applied Neuropsychology*, *7*, 17–24.

Rossini, P. M., Altamura, C., Ferretti, A., Vernieri, F., Zappasodi, F., Caulo, M., et al. (2004). Does cerebrovascular disease affect the coupling between neuronal activity and local haemodynamics? *Brain*, *127*, 99–110.

Rotermann, M. (2008). Trends in teen sexual behaviour and condom use. *Health Reports*, *19*, 53–57.

Roth, S. H., Fleischmann, R. M., Burch, F. X., Dietz, F., Bockow, B., Rapoport, R. J., et al. (2000). Around-the-clock, controlled-release oxycodone therapy for osteoarthritis-related pain: Placebo-controlled trial and long-term evaluation. *Archives of Internal Medicine*, *160*, 853–860.

Rothbart, M. K., & Bates, J. E. (2006). Temperament. In W. Damon, R. Lerner, & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (6th ed., pp. 99–166). New York: Wiley.

Rouder, J. N., & Ratcliff, R. (2004). Comparing categorization models. *Journal of Experimental Psychology: General*, *133*, 63–82.

Rouder, J. N., & Ratcliff, R. (2006). Comparing exemplar- and rule-based theories of categorization. *Current Directions in Psychological Science*, *15*, 9–13.

Rowe, R., Maughan, B., Worthman, C. M., Costello, E. J., & Angold, A. (2004). Testosterone, antisocial behavior, and social dominance in boys: Pubertal development and biosocial interaction. *Biological Psychiatry*, *55*, 546–552.

Rowland, A. S., Skipper, B. J., Umbach, D. M., Rabiner, D. L., Campbell, R. A., ... Sandler, D. P. (2015). The prevalence of ADHD in a population-based sample. *Journal of Attention Disorders*, *19*, 741–754.

Rozanski, A., Blumenthal, J. A., & Kaplan, J. (1999). Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation*, *99*, 2192–2217.

Rozental, A., Andersson, G., & Carlbring, P. (2019). In the absence of effects : An individual patient data meta-analysis of non-response

and its predictors in internet-based cognitive behavior therapy. *Frontiers in Psychology*, *10*, article 589.

Rubin, D., & Wenzel, A. (1996). One hundred years of forgetting: A quantitative description of retention. *Psychological Review*, *103*, 734–760.

Rudman, L. A., Feinburg, J., & Fairchild, K. (2002). Minority members' implicit attitudes: Automatic ingroup bias as a function of group status. *Social Cognition*, *20*, 294–320.

Rule, N. O., & Ambady, N. (2008). Brief exposures: Male sexual orientation is accurately perceived at 50 ms. *Journal of Experimental Social Psychology*, *44*, 1100–1105.

Rule, N. O., & Ambady, N. (2010). Democrats and Republicans can be differentiated from their faces. *PLoS ONE*, *5*, e8733.

Rule, N. O., Macrae, C. N., & Ambady, N. (2009). Ambiguous group membership is extracted automatically from faces. *Psychological Science*, *20*, 441–443.

Rusak, B. (1979). Neural mechanisms for entrainment and generation of mammalian circadian rhythms. *Federation Proceedings*, *38*, 2589–2595.

Ruseckaite, R., Maddess, T., Danta, G., Lueck, C. J., & James, A.C. (2005). Sparse multifocal stimuli for the detection of multiple sclerosis.

Annals of Neurology, *57*, 904–913.

Rushton, J. P., & Jensen, A. R. (2005). Thirty years of research on race differences in cognitive ability. *Psychology, Public Policy, and Law*, *11*, 235–294.

Rushton, J. P., Chrisjohn, R. D., & Fekken, G. C. (1981). The altruistic personality and the self-report altruism scale. *Personality and Individual Differences*, *2*, 293–302.

Rutjens, B. T., & Kay, A. C. (2017). Compensatory control theory and the psychological importance of perceiving order. In M. Bukowski, I. Fritsche, A. Guinote, & M. Kofta (Eds.), *Current issues in social psychology. Coping with lack of control in a social world* (pp. 83–96). New York: Routledge/Taylor & Francis Group.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*, 68–78.

Sacerdote, B. (2001). Peer effects with random assignment: Results for Dartmouth roommates. *Quarterly Journal of Economics*, *116*, 681–704.

Sachs, G. T. L. (1812). *Historiae naturalis duorum leucaetiopum: Auctoris ipsius et sororis eius*. Erlangen. [Online]. Retrieved from http://mdz10.bib-bvb.de/~db/0001/bsb00012567/images/

Sackett, P. R, Walmsley, P. T. (2014). Which personality attributes are most important in the workplace? *Perspectives on Psychological Science*, *9*, 538–551.

Safdar, S. F., & Lay, C. H. (2003). The relations of immigrant-specific and immigrant-nonspecific daily hassles to distress controlling for psychological adjustment and cultural competence. *Journal of Applied Social Psychology*, *33*, 299–320.

Safron, A., Klimaj, V., Sylva, D., Rosenthal, A. D., Li, M., ... Bailey, J. M. (2018). Neural correlates of sexual orientation in heterosexual, bisexual, and homosexual women. *Scientific Reports*, *8*, 1–15.

Sagberg, F. (1999). Road accidents caused by drivers falling asleep. *Accident Analysis & Prevention*, *31*, 639–649.

Saha, S., Chant, D., Welham, J., & McGrath, J. (2005). A systematic review of the prevalence of schizophrenia. *PLoS Medicine*, *2*, e141.

Sahakian, B., & Morein-Zamir, S. (2007). Professor's little helper. *Nature*, *450*, 1157–1159.

Sahdra, B. K., MacLean, K. A., Ferrer, E., Shaver, P. R., Rosenberg, E. L., Jabocs, T. L., et al. (2011). Enhanced response inhibition during intensive meditation training predicts improvements in self-reported adaptive socioemotional functioning. *Emotion*, *11*, 299–312.

Salthouse, T. A. (1987). The role of representations in age differences in analogical reasoning. *Psychology and Aging*, *2*, 357–362.

Salvatore, J. E., I-Chun Kuo, S., Steele, R. D., Simpson, J. A., & Collins, W. A. (2011). Recovering from conflict in romantic relationships: A developmental perspective. *Psychological Science*, *22*, 376–383.

Sankar, A., & Fu, C. H. Y. (2016). Psychotherapy and antidepressant treatment effects on the functional neuroanatomy of depression. *Psychopathology Review*, *1*, 16–28.

Santelli, J. S., Kantor, L. M., Grilo, S. A., Speizer, I. S., Lindberg, L. D., ... Ott, M. A. (2017). Abstinence-only-until-marriage : An updated review of U.S. policies and programs and their impact. *Journal of Adolescent Health*, *61*, 273–280.

Sargent, J. D. (2005). Smoking in the movies: Impact on adolescent smoking. *Adolescent Medicine*, *16*, 345–370.

Satel, S. & Lilienfeld, S. O. (2013). Addiction and the brain-disease fallacy. *Frontiers in Psychiatry*, *3*, 141.

Saucier, G., Bel-Bahar, T., & Fernandez, C. (2007). What modifies the expression of personality tendencies? Defining basic domains of situation variables. *Journal of Personality*, *75*, 479–504.

Saucier, G., Georgiades, S., Tsaousis, I., & Goldberg, L. R. (2005). The factor structure of Greek personality adjectives. *Journal of*

Personality and Social Psychology, *88*, 856–875.

Saus, E., Johnsen, B., Eid, J., Riisem, P., Andersen, R., & Thayer, J. (2006). The effect of brief situational awareness training in a police shooting simulator: An experimental study. *Military Psychology*, *18*, s3–s21.

Savage-Rumbaugh, S., & Lewin, R. (1994). *Kanzi: The ape at the brink of the human mind*. New York: Wiley.

Savic, I., & Lindström, P. (2008). PET and MRI show differences in cerebral asymmetry and functional connectivity between homo- and heterosexual subjects. *Proceedings of the National Academy of Sciences of the United States of America*, *105*, 9403–9408.

Savic, I., Berglund, H., Lindström, P., & Gustafsson, J. (2005). Brain response to putative pheromones in homosexual men. *Proceedings of the National Academy of Sciences of the United States of America*, *102*, 7356–7361.

Savin-Williams, R. C., & Cohen, K. M. (2004). Homoerotic development during childhood and adolescence. *Child Adolescent Psychiatric Clinics of North America*, *13*, 529–549.

Saxena, S., Brody, A. L., Schwartz, J. M., & Baxter, L. R. (1998). Neuroimaging and frontal-subcortical circuitry in obsessive-compulsive disorder. *British Journal of Psychiatry*, *173*, 26–37.

Saxon, A. H. (1989). *P. T. Barnum: The legend and the man*. New York: Columbia University Press.

Schachter, S., & Singer, J. (1962). Cognitive, social, and physiological determinants of emotional state. *Psychological Review*, *69*, 379–399.

Schaie, K. W. (1994). The course of adult intellectual development. *American Psychologist*, *49*, 304–313.

Schaller, M., & Murray, D. R. (2008). Pathogens, personality and culture: Disease prevalence predicts worldwide variability in sociosexuality, extraversion, and openness to experience. *Journal of Personality and Social Psychology*, *95*, 212–221.

Scheier, M. F., & Carver, C. S. (1985). Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology*, *4*, 219–247.

Schenck, C. H., & Mahowald, M. (2002). REM sleep behavior disorder: Clinical, developmental, and neuroscience perspectives 16 years after its formal identification. *Sleep*, *25*, 120–138.

Schenck, C. H., Arnulf, I., & Mahowald, M. W. (2007). Sleep and sex: What can go wrong? A review of the literature on sleep-related disorders and abnormal sexual behaviours and experiences. *Sleep*, *30*, 683–702.

Schenck, C. H., Milner, D. M., Hurwitz, T. D., Bundlie, S. R., & Mahowald, M. W. (1989). A polysomnographic and clinical report on sleep-related injury in 100 adult patients. *American Journal of Psychiatry*, *146*, 1166–1173.

Schierenbeck, T., Riemann, D., Berger, M., & Hornyak, M. (2008). Effect of illicit recreational drugs upon sleep: Cocaine, ecstasy and marijuana. *Sleep Medicine Reviews*, *12*, 381–389.

Schimel, J., Hayes, J., Williams, T., & Jahrig, J. (2007). Is death really the worm at the core? Converging evidence that worldview threat increases death-thought accessibility. *Journal of Personality and Social Psychology*, *92*, 789–803.

Schinka, J. A., Busch, R. M., & Robichaux-Keene, N. (2004). A meta-analysis of the association between the serotonin transporter gene polymorphism (5HTTLPR) and trait anxiety. *Molecular Psychiatry*, *9*, 197–202.

Schlaug, G., Marchina, S., & Norton, A. (2009). Evidence for plasticity in white matter tracts of chronic aphasic patients undergoing intense intonation-based speech therapy. *Annals of the New York Academy of Sciences*, *1169*, 385–394.

Schlaug, G., Renga, V., & Nair, D. (2008). Transcranial direct current stimulation in stroke recovery. *Archives of Neurology*, *65*, 1571–1576.

Schmader, T., Johns, M., & Forbes, C. (2008). An integrated process model of stereotype threat effects on performance. *Psychological*

Review, *115*, 336–356.

Schmahmann, J. D. (2004). Disorders of the cerebellum: Ataxia, dysmetria of thought, and the cerebellar cognitive affective syndrome. *Journal of Neuropsychiatry and Clinical Neuroscience*, *16*, 367–378.

Schmahmann, J. D., & Sherman, J. C. (1998). The cerebellar cognitive affective syndrome. *Brain*, *121*, 561–579.

Schmidt, F. L., & Hunter, J. E. (1993). Tacit knowledge, practical intelligence, general mental ability and job knowledge. *Current Directions in Psychological Science*, *2*, 8–9.

Schmidt, F. L., & Hunter, J. E. (1998). The validity and utility of selection methods in personnel psychology: Practical and theoretical implications of 85 years of research findings. *Psychological Bulletin*, *124*, 262–274.

Schmidt, G. (2000). Remote, northern communities. *International Social Work*, *43*, 337–349.

Schmidt, M., & Butterweck, V. (2015). The mechanisms of action of St. John′s wort: An update. *Wiener Medizinische Wochenschrift*, *165*, 229–235.

Schmidt, M. E., Pempek, T. A., Kirkorian, H. L., Lund, A. F., & Anderson, D. R. (2008). The effect of background television on the toy play

behavior of very young children. *Child Development*, *79*, 1137–1151.

Schmidt, M. E., Rich, M., Rifas-Shiman, S. L., Oken, E., & Traveras, E. M. (2009). Viewing television in infancy and child cognition at 3 years of age in a US cohort. *Pediatrics*, *123*, e370–e375.

Schmidt, M., & Butterweck, V. (2015). The mechanisms of action of St. John's wort: An update. *Wiener Medizinische Wochenschrift*, *165*, 229–235.

Schmidt, U., Humfress, H., & Treasure, J. (1997). The role of general family environment and sexual and physical abuse in the origins of eating disorders. *European Eating Disorders Review*, *5*, 184–207.

Schmitt, D. P., Allik, J., McCrae, R. R., Benet-Martinez, V. (2007). The geographic distribution of Big Five personality traits: Patterns and profiles of human self-descriptions across 56 nations. *Journal of Cross-Cultural Psychology*, *38*, 173–212.

Schmitt, D. P., Realo, A., Voracek, M., & Allik, J. (2008). Why can't a man be more like a woman? Sex differences in Big Five personality traits across 55 cultures. *Journal of Personality and Social Psychology*, *94*, 168–182.

Schnakers, C., Vanhaudenhuyse, A., Giacino, J., Ventura, M., Boly, M., Majerus, S., et al. (2009). Diagnostic accuracy of the vegetative and minimally conscious state: Clinical consensus versus standardized neurobehavioral assessment. *BMC Neurology*, *9*, 35.

Schneider, S. M., Kisby, C. K., & Flint, E. P. (2011). Effect of virtual reality on time perception in patients receiving chemotherapy. *Support Care Cancer*, *19*, 555–564.

Schoenberger, N. E., Kirsch, I., Gearan, P., Montgomery, G., Pastyrnak, S., et al. (1997). Hypnotic enhancement of a cognitive behavioral treatment for public speaking anxiety. *Behavior Therapy*, *28*, 127–140.

Scholz, J., Klein, M.C., Behrens, T.E.J., & Johansen-Berg, H. (2009). Training induces in white-matter architecture. *Nature Neuroscience*, *12*, 1370–1371.

Schottenbauer, M. A., Momenan, R., Kerick, M., & Hommer, D. W. (2007). Relationships among aging, IQ, and intracranial volume in alcoholics and control subjects. *Neuropsychology*, *21*, 337–345.

Schredl, M. (2001). Night terrors in children: Prevalence and influencing factors. *Sleep and Hypnosis*, *3*, 68–72.

Schredl, M. (2003). Effects of state and trait factors on nightmare frequency. *European Archives of Psychiatry and Clinical Neuroscience*, *253*, 241–247.

Schreurs, B. G. (1993). Long-term memory and extinction of the classically conditioned rabbit nictitating membrane response. *Learning and Motivation*, *24*, 293–302.

Schreurs, B. G., Gusev, P. A., Tomsic, D., Alkon, D. L., & Shi, T. (1998). Intracellular correlates of acquisition and long-term memory of classical conditioning in Purkinje cell dendrites in slices of rabbit cerebellar lobule HVI. *Journal of Neuroscience*, *18*, 5498–5507.

Schroeder, D. A., Penner, L. A., Dovidio, J. F., & Piliavin, J. A. (1995). *The psychology of helping and altruism: Problems and puzzles*. New York: McGraw-Hill.

Schroers, M., Prigot, J., & Fagen, J. (2007). The effect of a salient odor context on memory retrieval in young infants. *Infant Behavior and Development*, *30*, 685–689.

Schultheiss, O. C., & Brunstein, J. C. (2001). Assessing implicit motives with a research version of the TAT: Picture profiles, gender differences, and relations to other personality measures. *Journal of Personality Assessment*, *77*, 71–86.

Schultheiss, O. C., Wirth, M. M., Torges, C. M., Pang, J. S., Villacorta, M. A., & Welsh, K. M. (2005). Effects of implicit power motivation on men's and women's implicit learning and testosterone changes after social victory or defeat. *Journal of Personality and Social Psychology*, *88*, 174–188.

Schultz, P. W., & Zelezny, L. (2003). Reframing environmental messages to be congruent with American values. *Human Ecology Review*, *10*, 126–136.

Schultz, W. (1998). Predictive reward signal of dopamine neurons. *Journal of Neurophysiology*, *80*, 1–27.

Schultz, W. (2000). Multiple reward signals in the brain. *Nature Reviews Neuroscience*, *1*, 199–207.

Schultz, W., & Dickinson, A. (2000). Neuronal coding of prediction errors. *Annual Review of Neuroscience*, *23*, 473–500.

Schultz, W., Tremblay, L., & Hollerman, J. R. (2000). Reward processing in primate orbitofrontal cortex and basal ganglia. *Cerebral Cortex*, *10*, 272–283.

Schulz-Hardt, S., Frey, D., Luthgens, C., & Moscovici, S. (2000). Biased information search in group decision making. *Journal of Personality and Social Psychology*, *78*, 655–669.

Schulze, L., Dziobek, I., Vater, A., Heekeren, H. R., Bajbouj, M., … Roepke, S. (2013). Gray matter abnormalities in patients with narcissistic personality disorder. *Journal of Psychiatric Research*, *47*, 1363–1369.

Schutter, D. J. L. G., Hofman, D., & Van Honk, J. (2008). Fearful faces selectively increase corticospinal motor tract excitability: A transcranial magnetic stimulation study. *Psychophysiology*, *45*, 345–348.

Schwaba, T., Luhmann, M., Denissen, J. J. A., Chung, J. M., & Bleidorn, W., (2018). Openness to experience and culture-openness transactions across the lifespan. *Journal of Personality and Social Psychology*, *115*, 118–136.

Schwartz, B., Ward, A., Monterosso, J., Lyubomirsky, S., White, K., & Lehman, D. R. (2002). Maximizing versus satisficing: Happiness is a matter of choice. *Journal of Personality and Social Psychology*, *83*, 1178–1197.

Schwartz, T. A., Ware, J., Fischer, C. E., Craik, F. I. M., & Bialystok, E. (2012). Bilingualism as a contributor to cognitive reserve: Evidence from brain atrophy in Alzheimer's disease. *Cortex*, *48*, 991–996.

Schweizer, T. A., Oriet, C., Meiran, N., Alexander, M. P., Cusimano, M., & Stuss, D.T. (2007). The cerebellum mediates conflict resolution. *Journal of Cognitive Neuroscience*, *19*, 1974–1982.

Schweizer, T. A., Ware, J., Fischer, C. E., Craik, F. I., Bialystok, E. (2012). Bilingualism as a contributor to cognitive reserve: Evidence from brain atrophy in Alzheimer's disease. *Cortex*, *48*, 991–996.

Scoboria, A., Mazzoni, G., Kirsch, I., & Jimenez, S. (2006). The effects of prevalence and script information on plausibility belief and memory of autobiographical events. *Applied Cognitive Psychology*, *20*, 1049–1064.

Scoville, W. B., & Milner, B. (1957). Loss of recent memory after bilateral hippocampal lesions. *Journal of Neurology, Neurosurgery, and*

Psychiatry, *20*, 11–21.

Sculthorpe-Petley, L., Liu, C., Ghosh Hajra, S., Parvar, H., Satel, J., Trappenberg, T. P., ... D'Arcy, R. C. N. (2015). A rapid event-related potential (ERP) method for point-of-care evaluation of brain function: Development of the Halifax Consciousness Scanner. *Journal of Neuroscience Methods*, *245*, 64–72.

Seale, J. P., Shellenberger, S., Rodriguez, C., Seale, J. D., & Alvarado, M. (2002). Alcohol use and cultural change in an indigenous population: A case study from Venezuela. *Alcohol and Alcoholism*, *37*, 603–608.

Sealy, P., & Whitehead, P. C. (2006). The impact of deinstitutionalization of psychiatric hospitals on psychological distress of the community in Canada. *Journal of Health & Social Policy*, *21*, 73–94.

Sears, H. A., & Byers, E. S. (2010). Adolescent girls' and boys' experiences of psychologically, physically, and sexually aggressive behaviors in their dating relationships: Co-occurrence and emotional reaction. *Journal of Aggression, Maltreatment & Trauma*, *19*, 517–539.

Sedikides, C., & Strube, M. J. (1995). The multiply motivated self. *Personality and Social Psychology Bulletin*, *21*, 1330–1335.

Segal Z. V., Williams J. M. G., & Teasdale J. D. (2002). *Mindfulness-based cognitive therapy for depression: A new approach to preventing relapse*. New York: Guilford.

Segalowitz, S. J., Santesso, D. L., Willoughby, T., Reker, D. L., Campbell, K., ... Rose-Krasnor, L. (2012). Adolescent peer interaction and trait surgency weaken medial prefrontal cortex responses to failure. *Social, Cognitive, and Affective Neuroscience*, *7*, 115–124.

Segerstrom, S. C., & Miller, G. E. (2004). Psychological stress and the immune system: A meta-analytic study of 30 years of inquiry. *Psychological Bulletin*, *130*, 601–630.

Seidenberg, M. S., & Pettito, L. A. (1979). Signing behavior in apes: A critical review. *Cognition*, *7*, 177–215.

Selemon, L. D., & Zecevic, N. (2015). Schizophrenia: A tale of two critical periods for prefrontal cortical development. *Translational Psychiatry*, *5*, e623.

Selemon, L. D., Rajkowska, G., & Goldman-Rakic, P. S. (1995). Abnormally high neuronal density in the schizophrenic cortex: A morphometric analysis of prefrontal area 9 and occipital area 17. *Archives of General Psychiatry*, *52*, 805–818.

Seligman, M. E., & Maier, S. F. (1967). Failure to escape traumatic shock. *Journal of Experimental Psychology*, *74*, 1–9.

Seligman, M. E. P. (1971). Phobias and preparedness. *Behavior Therapy*, *2*, 307–320.

Seligman, M. E. P., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist*, *55*, 5–14.

Seligman, M. E. P., Abramson, L. Y., Semmel, A., & von Baeyer, C. (1979). Depressive attributional style. *Journal of Abnormal Psychology*, *88*, 242–247.

Selten, J. P., van der Ven, E., Rutten, B. P., & Cantor-Graae, E. (2013). The social defeat hypothesis of schizophrenia: An update. *Schizophrenia Bulletin*, *39*, 1180–1186.

Selye, H. (1950). Stress and the general adaptation syndrome. *British Medical Journal*, 1385–1392.

Selye, H. (1955). Stress and disease. *Science*, *122*, 625–631.

Selye, H. (1956). *The stress of life*. New York: McGraw-Hill.

Sen, B., & Swaminathan, S. (2007). Maternal prenatal substance use and behavior problems among children in the US. *Journal of Mental Health Policy and Economics*, *10*, 189–206.

Senghas, A. (2003). Intergenerational influence and ontogenetic development in the emergence of spatial grammar in Nicaraguan Sign Language. *Cognitive Development*, *18*, 511–531.

Senghas, A., Kita, S., & Ozyurek, A. (2004). Children creating core properties of language: Evidence from an emerging sign language

in Nicaragua. *Science*, *305*, 1779–1782.

Serafini, G., Pompili, M., Belvederi Murri, M., Respino, M., Ghio, L., ... Amore, M. (2015). The effects of repetitive transcranial magnetic stimulation on cognitive performance in treatment-resistant depression: A systematic review. *Neuropsychobiology*, *71*, 125–139.

Sergent, J., Ohta, S., & MacDonald, B. (1992). Functional neuroanatomy of face and object processing: A positron emission tomography study. *Brain*, *115*, 15–36.

Sessa, B., Higbed, L., & Nutt, D. (2019). A review of 3,4-methylenedioxymethamphetamine (MDMA)-assisted psychotherapy. *Frontiers in Psychiatry*, *10*, article 138.

Setchell, J. M., & Wickings, E. J. (2004). Social and seasonal influences on the reproductive cycle in female mandrills (Mandrillus sphinx). *American Journal of Physical Anthropology*, *125*, 73–84.

Sevcikova, A., & Konečný, Š. (2011). An exploration of the relationship between real-world sexual experience and online sexual activity among 17 year old adolescents. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, *5*, article 3.

Shad, M. U., Bidesi, A. S., Chen, L-A., Thomas, B. P., Ernst, M., & Rao, U. (2011). Neurobiology of decision-making in adolescents. *Behavioural Brain Research*, *217*, 67–76.

Shamosh, N. A., DeYoung, C. G., Green, A. E., Reis, D. L., Johnson, M. R., Conway, A. R. A., et al. (2008). Individual differences in delay discounting: Relation to intelligence, working memory, and anterior prefrontal cortex. *Psychological Science*, *19*, 904–911.

Shapiro, A. F., Gottman, J. M., & Carrère, S. (2000). The baby and the marriage: Identifying factors that buffer against decline in marital satisfaction after the first baby arrives. *Journal of Family Psychology*, *14*, 59–70.

Shapiro, C. M., Tranjanovic, N. N., & Fedoroff, J. P. (2003). Sexsomnia—A new parasomnia? *Canadian Journal of Psychiatry*, *48*, 311–317.

Shariff, A. F., & Tracy, J. L. (2011). What are emotion expressions for? *Current Directions in Psychological Science*, *20*, 395–399.

Sharot, T., & Phelps, E. A. (2004). How emotional arousal modulates memory: Disentangling the effects of attention and retention. *Cognitive Affective Behavioural Neuroscience*, *4*, 294–306.

Sharot, T., Martorella, E. A., Delgado, M. R., & Phelps, E. A. (2007). How personal experience modulates the neural circuitry of memories of September 11. *Proceedings of the National Academy of Sciences of the United States of America*, *104*, 389–394.

Sharp, W., Hargrove, D., Johnson, L., & Deal, W. (2006). Mental health education: An evaluation of a classroom based strategy to modify help seeking for mental health problems. *Journal of College Student Development*, *47*, 419–438.

Shaughnessy, K., Byers, E. S., Clowater, S. L., & Kalinowski, A. (2014). Self-appraisals of arousal-oriented online sexual activities in university and community samples. *Archives of Sexual Behavior*, *43*, 1187–1197.

Shaywitz, S. E. (1998). Dyslexia. *Current Concepts*, *338*, 307–312.

Shaywitz, S. E., & Shaywitz, B. A. (1991). Introduction to the special series on attention deficit disorder. *Journal of Learning Disabilities*, *24*, 68–71.

Sheline, Y. I., Barch, D. M., Donnelly, J. M., Ollinger, J. M. Snyder, A. Z., & Mintun, M. A. (2001). Increased amygdala response to masked emotional faces in depressed subjects resolves with antidepressant treatment: An fMRI study. *Biological Psychiatry*, *50*, 651–658.

Shenton, M. E., Hamoda, H. M., Schneiderman, J. S., Bouix, S., Pasternak, O., ... Zafonte, R. (2012). A review of magnetic resonance imaging and diffusion tensor imaging findings in mild traumatic brain injury. *Brain Imaging and Behavior*, *6*, 137–192.

Shepperd, J. A., & Koch, E. (2005). Pitfalls in teaching judgment heuristics. *Teaching of Psychology*, *32*, 43–46.

Sheridan, M A., Fox, N. A., Zeanah, C. H., McLaughlin, K. A., & Nelson, C. A. (2012). Variation in neural development as a result of exposure to institutionalization early in childhood. *Proceedings of the*

National Academy of Sciences of the United States of America, *109*, 12927–12932.

Sherif, M. (1961). *The robbers cave experiment: Intergroup conflict and cooperation*. Middletown, CT: Wesleyan University Press.

Sherman, S. M. (2007). The thalamus is more than just a relay. *Current Opinion in Neurobiology*, *17*, 417–422.

Sherman, S. M., & Guillery, R. W. (1996). Functional organization of thalamocortical relays. *Journal of Neurophysiology*, *76*, 1367–1395.

Sherrard, L., Hiebert, J., & Squires, S. (2015). *Canada communicable disease report: Measles elimination*. CCDR Volume 41-7. Public Health Agency of Canada. Retrieved from www.phac-aspc.gc.ca/publicat/ccdr-rmtc/15vol41/dr-rm41-07/ar-01-eng.php

Shi, R., & Werker, J. F. (2001). Six-month-old infants' preferences for lexical words. *Psychological Science*, *12*, 70–75.

Shi, R., Werker, J. F., & Morgan, J. L. (1999). Newborn infants' sensitivity to perceptual cues to lexcial and grammatical words. *Cognition*, *72*, B11–B21.

Shibley Hyde, J. (2014). Gender similarities and differences. *Annual Review of Psychology*, *65*, 373–398.

Shields, G. S., Sazma, M. A., McCullough, A. M., & Yonelinas, A. P. (2017). The effects of acute stress on episodic memory: A meta-analysis and integrative review. *Psychological Bulletin*, *143*, 636–675.

Shields, M., & Tjekema, M. (2006). Regional differences in obesity. *Health Reports*, *17*, 61–67.

Shields, M., Carroll, M. D., & Ogden, C. L. (2011). Adult obesity prevalence in Canada and the United States. *Advances in Nutrition*, *2*, 368–369.

Shmueli, D., Prochaska, J. J., & Glantz, S. A. (2010). Effect of smoking scenes in films on immediate smoking: A randomized controlled study. *American Journal of Preventative Medicine*, *38*, 351–358.

Shorter, E. (1997). *The history of psychiatry: From the era of the asylum to the age of Prozac*. Toronto: John Wiley Sons, Inc.

Shu, N., Liu, Y., Li, K., Duan, Y., Wang, J., ... He, Y. (2011). Diffusion tensor tractography reveals disrupted topological efficiency in white matter structural networks in multiple sclerosis. *Cerebral Cortex*, *11*, 2565–2577.

Shulgin, A. T., & Nichols, D. E. (1978). Characterization of three new psychotomimetics. In R. C. Stillman and R. E. Willette (Eds.), *The psychopharmacology of hallucinogens* (pp. 74–83). New York: Pergamon Press.

Sibley, C. G., & Duckitt, J. (2008). Personality and prejudice: A meta-analysis and theoretical review. *Personality and Social Psychology Review*, *12*, 248–279.

Siegel, D. (2007). *The mindful brain: Reflection and attunement in the cultivation of well-being*. New York: W. W. Norton & Company.

Siegel, J. (1995). Phylogeny and the function of REM sleep. *Behavioural Brain Research*, *69*, 29–34.

Siegel, J. (2005). Clues to the functions of mammalian sleep. *Nature*, *437*, 1264–1271.

Siegel, S. (1984). Pavlovian conditioning and heroin overdose: Reports by overdose victims. *Bulletin of the Psychonomic Society*, *22*, 428–430.

Siegel, S. (2016). The heroin overdose mystery. *Current Directions in Psychological Science*, *25*, 375–379.

Siegel, S., Baptista, M. A. S., Kim, J. A., McDonald, R. V., & Weise-Kelly, L. (2000). Pavlovian psychopharmacology: The associative basis of tolerance. *Experimental and Clinical Psychopharmacology*, *8*, 276–293.

Siegel, S., Hinson, R. E., Krank, M. D., & McCully, J. (1982). Heroin "overdose" death: Contribution of drug-associated environmental cues. *Science*, *216*, 436–437.

Siegler, R. S. (1992). The other Alfred Binet. *Developmental Psychology*, *28*, 179–190.

Silva, A. J., Paylor, R., Wehner, J. M., & Tonegawa, S. (1992). Impaired spatial learning in alpha-calcium-calmodulin kinase II mutant mice. *Science*, *257*, 206–211.

Silva, M., Groeger, J., & Bradshaw, M. (2006). Attention–memory interactions in scene perception. *Spatial Vision*, *19*, 9–19.

Silverman, I., & Eals, M. (1992). Sex differences in spatial abilities: Evolutionary theory and data. In J. Barkow, L. Cosmides, & J. Tooby (Eds.), *The adapted mind: Evolutionary psychology and the generation of culture* (533–549). Oxford, UK: Oxford University Press.

Silverman, I., Choi, J., & Peters, M. (2007). The hunter-gatherer theory of sex differences in spatial abilities: Data from 40 countries. *Archives of Sexual Behavior*, *36*, 261–268.

Simmons, H.G. (1990). *Unbalanced: Mental health policy in Ontario, 1930–1989*. Toronto, ON: Wall & Thompson.

Simmons, J. P., & Simonsohn, U. (2017). Power posing: P-curving the evidence. *Psychological Science*, *28*, 687–693.

Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception*, *28*, 1059–

1074.

Simons, D. J., & Levin, D. T. (1997). Change blindness. *Trends in Cognitive Sciences*, *1*, 261–267.

Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., ... Stine-Morrow, E. A. L. (2016). Do “brain training” programs work? *Psychological Science in the Public Interest*, *17*, 103–186.

Singer, M. A., & Goldin-Meadow, S. (2005). Children learn when their teacher’s gestures and speech differ. *Psychological Science*, *16*, 85–89.

Singer T., Kiebel, S. J., Winston, J. S., Dolan, R. J., & Frith, C. D. (2004). Brain responses to the acquired moral status of faces. *Neuron*, *41*, 653–662.

Singh, A., Uijtdewilligen, L., Twisk, J. W., van Mechelen, W., & Chinapaw, M. J. (2012). Physical activity and performance at school: A systematic review of the literature including a methodological quality assessment. *Archives of Pediatrics and Adolescent Medicine*, *166*, 49–55.

Sinha, R. (2009). Modeling stress and drug craving in the laboratory: Implications for addiction treatment development. *Addiction Biology*, *14*, 84–98.

Sireteanu, R. (1999). Switching on the infant brain. *Science*, *286*, 59–61.

Skinner, B. F. (1948). Superstition in the pigeon. *Journal of Experimental Psychology*, *38*, 168–172.

Skinner, B. F. (1985). Cognitive science and behaviorism. *British Journal of Psychology*, *76*, 291–301.

Skinner, M. K., Anway, M. D., Savenkova, M. I., Gore, A. C., & Crews, D. (2008). Transgenerational epigenetic programming of the brain transcriptome and anxiety behavior. *PLOS One*, e3745.

Skinner, T. C., Bruce, D. G., Davis, T. M., & Davis, W. A. (2014). Personality traits, self-care behaviours and glycaemic control of type 2 diabetes: The Fremantle diabetes study phase II. *Diabetic Medicine*, *31*, 487–492.

Slater, A., Morison, V., & Somers, M. (1988). Orientation discrimination and cortical function in the human newborn. *Perception*, *17*, 597–602.

Slotema, C. W., Blom, J. D., Hoek, H. W., & Sommer, I. E. (2010). Should we expand the toolbox of psychiatric treatment methods to include repetitive transcranial magnetic stimulation (rTMS)? A meta-analysis of the efficacy of rTMS in psychiatric disorders. *Journal of Clinical Psychiatry*, *71*, 873–884.

Slovic, P. (2007). If I look at the mass I will never act: Psychic numbing and genocide. *Judgment and Decision Making*, *2*, 79–95.

Slovic, P., Finucane, M., Peters, E., & MacGregor, D. G. (2002). Rational actors or rational fools: Implications of the affect heuristic for behavioral economics. *Journal of Socio-economics*, *31*, 329–342.

Small, B. J., Dixon, R. A., McArdle, J. J., & Grimm, K. J. (2012). Do changes in lifestyle engagement moderate cognitive decline in normal aging? Evidence from the Victoria Longitudinal Study. *Neuropsychology*, *26*, 144–155.

Small, D. A., Loewenstein, G., & Slovic, P. (2007). Sympathy and callousness: The impact of deliberative thought on donations to identifiable and statistical victims. *Organizational Behavior and Human Decision Processes*, *102*, 143–153.

Small, D. M., Jones-Gotman, M., & Dagher, A. (2003). Feeding-induced dopamine release in dorsal striatum correlated with meal pleasantness ratings in healthy human volunteers. *NeuroImage*, *19*, 1709–1715.

Small, D. M., Jones-Gotman, M., Zatorre, R. J., Petrides, M., Evans, A. C. (1997). Flavor processing: More than the sum of its parts. *Neuroreport*, *8*, 3913–3917.

Small, D. M., Zatorre, R. J., Dagher, A., Evans, A. C., & Jones-Gotman, M. (2001). Changes in brain activity related to eating chocolate. *Brain*, *124*, 1720–1733.

Smallwood, J., McSpadden, M., & Schooler, J. (2008). When attention matters: The curious incident of the wandering mind. *Memory &*

Cognition, *36*, 1144–1150.

Smallwood, J., Schooler, J. W., Turk, D. J., Cunningham, S. J., Burns, P., & Macrae, C. N. (2011). Self-reflection and the temporal focus on the wandering mind. *Consciousness and Cognition*, *20*, 1120–1126.

Smilek, D., Moffatt, B. A., Pasternak, J., White, B. N., Dixon, M. J., & Merikle, P. M. (2002). Synaesthesia: A case study of discordant monozygotic twins. *Neurocase*, *8*, 338–342.

Smith, A. C. (2016). Spring forward at your own risk: Daylight saving time and fatal vehicle crashes. *American Economic Journal: Applied Economics*, *8*, 65–91.

Smith, B. W. (2004). Structural and organizational predictors of homicide by police. *Policing: An International Journal of Police Strategies and Management*, *27*, 539–557.

Smith, C. (1993). Sleep and learning: Some recent findings. In A. Moffit, M. Kramer, & R. Hoffmann (Eds.), *The functions of dreaming*. Albany, NY: SUNY.

Smith, C. (2001). Sleep states and memory processes in humans: Procedural versus declarative memory systems. *Sleep Medicine Reviews*, *5*, 491–506.

Smith, C. T., Nixon, M. R., & Nadar, R. S. (2004). Posttraining increases in REM sleep intensity implicate REM sleep in memory processing

and provide a biological marker of learning potential. *Learning & Memory*, *11*, 714–719.

Smith, C., & Lapp, L. (1991). Increases in number of REMs and REM density in humans following an intensive learning period. *Journal of Sleep Research & Sleep Medicine*, *14*, 325–330.

Smith, E., & Delargy, M. (2005). Locked-in syndrome. *British Medical Journal*, *330*, 406–409.

Smith, S. D., & Kornelsen, J. (2011). Emotion-dependent responses in spinal cord neurons: A spinal fMRI study. *NeuroImage*, *58*, 269–274.

Smith, S. D., Fredborg, B. K., & Kornelsen, J. (2016). An examination of the default mode network in individuals with autonomous sensory meridian response (ASMR). *Social Neuroscience*, *12*, 361–365.

Smith, S. D., Kornelsen, J., & McIver, T. A. (2013). Putting the body back in embodied emotion: fMRI evidence for the modulation of spinal cord neurons by facial expressions. Poster presented at the 20th Annual meeting of the Cognitive Neuroscience Society, San Francisco, CA, April 13–16.

Smith, T. B., McCullough, M. E., & Poll, J. (2003). Religiousness and depression: Evidence for a main effect and the moderating influence of stressful life events. *Psychological Bulletin*, *129*, 614–636.

Smolen, P., Zhang, Y., & Byrne, J. H. (2016). The right time to learn: Mechanisms and optimization of spaced learning. *Nature Reviews Neuroscience*, *17*, 77–88.

Sniekers, S., Stringer, S., Watanabe, K., Jansen, P. R., Coleman, J. R. I., ... Posthuma, D. (2017). Genome-wide association meta-analysis of 78,308 individuals identifies new loci and genes influencing human intelligence. *Nature Genetics*, *49*, 1107–1112.

Snook, B., Eastwood, J., & Barron. T. (2014). The next stage in the evolution of interrogations: The PEACE model. *Canadian Criminal Law Review*, *18*, 219–239.

Snyder, K. (2006). Kurt Snyder's personal experience with schizophrenia. *Schizophrenia Bulletin*, *32*, 209–211. Permission conveyed through Copyright Clearance Center, Inc.

Sobel, H. S., Cepeda, N. J., & Kapler, I. V. (2011). Spacing effects in real-world classroom vocabulary learning. *Applied Cognitive Psychology*, *25*, 763–767.

Söderlund, H., Moscovitch, M., Kumar, N., Mandic, M., & Levine, B. (2012). As time goes by: Hippocampal connectivity changes with remoteness of autobiographical memory retrieval. *Hippocampus*, *22*, 670–679.

Solomon, K. D., Fernández de Castro, L. E., Sandoval, H. P., Biber, J. M., Groat, B., Neff, K. D., et al. (2009). LASIK world literature review:

Quality of life and patient satisfaction. *Ophthalmology*, *116*, 691–701.

Solomon, S., Greenberg, J., & Pyszczynski, T. (1991). A terror management theory of social behavior: The functions of self-esteem and cultural worldviews. In M. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 24, pp. 93–159). San Diego, CA: Academic Press.

Sommer, M., Sodian, B., Döhnel, K., Schwerdtner, J., Meinhardt, J., & Hajak, G. (2010). In psychopathic patients emotion attribution modulates activity in outcome-related brain areas. *Psychiatry Research*, *182*, 88–95.

Son Hing, L. S., Bobocel, D. R., Zanna, M. P., & McBride, M. V. (2007). Authoritarian dynamics and unethical decision making: High SDO leaders and high RWA followers. *Journal of Personality and Social Psychology*, *92*, 67–81.

Sovik, R. (2000). The science of breathing—The yoga view. *Progress in Brain Research*, *122*, 491–505.

Sowell, E. R., Peterson, B. S., Thompson, P. M., Welcome, S. E., Henkenius, A. L., & Toga, A. W. (2003). Mapping cortical change across the human life span. *Nature Neuroscience*, *6*, 309–315.

Spanos, N. P., Burgess, C. A., & Burgess, M. F. (1994). Past-life identities, UFO abductions, and satanic ritual abuse: The social construction

of memories. *International Journal of Clinical and Experimental Hypnosis*, *42*, 433–446.

Spanos, N., Cobb, P., & Gorassini, D. (1985). Failing to resist hypnotic test suggestions: A strategy for self-presenting as deeply hypnotized. *Psychiatry: Journal for the Study of Interpersonal Processes*, *48*, 282–292.

Speakman, J. R. (2015). The 'fat mass and obesity related' (FTO) gene: Mechanisms of impact on obesity and energy balance. *Current Obesity Reports*, *4*, 73–91.

Spearman, C. (1923). *The nature of intelligence and the principles of cognition*. London, UK: Macmillan.

Spearman, C. (1939). Thurstone's work re-worked. *The Journal of Educational Psychology*, *30*, 1–16.

Spector, F., & Maurer, D. (2009). Synesthesia: A new approach to understanding the development of perception. *Developmental Psychology*, *45*, 175–189.

Spelke, E. S., & Kinzler, K. D. (2007). Core knowledge. *Developmental Science*, *10*, 89–96.

Spera, S. P., Buhrfeind, E. D., & Pennebaker, J. W. (1994). Expressive writing and coping with job loss. *Academy of Management Journal*, *37*, 722–733.

Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs*, *74*, 1–29.

Sperry, R. W. (1951). Regulative factors in the orderly growth of neural circuits. *Growth, Suppl. 10*, 63–87.

Sperry, R. W. (1956). Experiments on perceptual integration in animals. *Psychiatric Research Reports*, *6*, 151–160.

Sperry, R. W. (1963). Chemoaffinity in the orderly growth of nerve fiber patterns and connections. *Proceedings of the National Academy of Sciences of the United States of America*, *50*, 703–710.

Sperry, R. W. (1968). Hemisphere deconnection and unity in conscious awareness. *American Psychologist*, *23*, 723–733.

Sperry, R. W. (1974). Lateral specialization in the surgically separated hemispheres. In F. O. Schmitt & F. G. Worden (Eds.), *The neurosciences third study program* (pp. 5–19). Cambridge, MA: MIT Press.

Sperry, R. W. (1982). Some effects of disconnecting the cerebral hemispheres. *Science*, *217*, 1223–1226, 1250.

Spires-Jones, T., & Knafo, S. (2012). Spines, plasticity, and cognition in Alzheimer's model mice. *Neural Plasticity*, *2012*, 1–10.

Springer, S. P., & Deutsch, G. (1998). *Left brain right brain: Perspective from cognitive neuroscience*. New York: Freeman.

Sproule, B., Brands, B., Li, S., & Catz-Biro, L. (2009). Changing patterns in opioid addiction. *Canadian Family Physician*, *55*, 68–69, e1–5.

Squeglia, L. M., Jacobus, J., & Tapert, S. F. (2009). The influence of substance use on adolescent brain development. *Clinical EEG and Neuroscience*, *40*, 31–38.

Squire, L. R. (1986). Mechanisms of memory. *Science*, *232*, 1612–1619.

Squire, L. R. (1989). On the course of forgetting in very long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *15*, 241–245.

Squire, L. R., Wixted, J. T., & Clark, R. E. (2007). Recognition memory and the medial temporal lobe: A new perspective. *Nature Reviews Neuroscience*, *8*, 872–83.

Stack, S. & Eshleman, J. R. (1998). Marital status and happiness: A 17-nation study. *Journal of Marriage and Family*, *60*, 527–536.

Staffen, W., Kronbichler, M., Aichhorn, M., Mair, A., & Ladurner, G. (2006). Selective brain activity in response to one's own name in the persistent vegetative state. *Journal of Neurology, Neurosurgery, and Psychiatry*, *77*, 1383–1384.

Stafford, L. D., Salchi, S., & Waller, B. M. (2009). Odors cue memory for odor-associated words. *Chemosensory Perception*, *2*, 59–69.

Stanhope, N., Cohen, G., & Conway, M. (1993).Very long-term retention of a novel. *Applied Cognitive Psychology*, *7*, 239–256.

Stanovich, K. E., & West, R. F. (2000). Individual differences in reasoning: Implications for the rationality debate? *Behavioral and Brain Sciences*, *23*, 645–665.

Starcevic, V., Linden, M., Uhlenhuth, E. H., Kolar, D., & Latas, M. (2004). Treatment of panic disorder with agoraphobia in an anxiety disorders clinic: Factors influencing psychiatrists′ treatment choices. *Psychiatry Research*, *125*, 41–52.

Stark, C. E., Okado, Y., & Loftus, E. F. (2010). Imaging the reconstruction of true and false memories using sensory reactivation and the misinformation paradigms. *Learning and Memory*, *17*, 485–488

Statistica. (2017). Canada: Degree of urbanization from 2007 to 2017. Retrieved from www.statista.com/statistics/271208/urbanization-in-canada/

Statistics Canada. (2003). Canadian community health survey: Mental health and well-being 2002. Retrieved from www.statcan.gc.ca/pub/82-617-x/index-eng.htm

Statistics Canada. (2004). Table 101–6511, 30 and 50 year total divorce rates per 1,000 marriages, Canada, provinces and territories, annual (rate per 1,000 marriages), CANSIM (database). (Retrieved 2013-11–05.)

Statistics Canada. (2011). Adult obesity prevalence in Canada and the United States. Health facts sheet. Retrieved from www.statcan.gc.ca/pub/82-625-x/2012001/article/11664-eng.htm

Statistics Canada. (2012a). Leading causes of death, by sex. Retrieved from www.statcan.gc.ca/tables-tableaux/sum-som/l01/cst01/hlth36a-eng.htm

Statistics Canada. (2012b). Portrait of families and living arrangements in Canada. www12.statcan.gc.ca/census-recensement/2011/as-sa/98-312-x/98-312-x2011001-eng.pdf

Statistics Canada. (2013a). Mental and substance use disorders in Canada. Retrieved from: www150.statcan.gc.ca/n1/pub/82-624-x/2013001/article/11855-eng.htm

Statistics Canada. (2013b). Select health indicators of First Nations people living off reserve, Metis and Inuit. Retrieved from www.statcan.gc.ca/pub/82-624-x/2013001/article/11763-eng.htm

Statistics Canada. (2013c). Summary of results for 2013: Canadian Tobacco, Alcohol and Drugs Survey (CTADS). Retrieved from http://healthycanadians.gc.ca/science-research-sciences-

recherches/data-donnees/ctads-ectad/summary-sommaire-2013-eng.php

Statistics Canada. (2016). Health indicators. Catalogue no. 82-221-X. Retrieved from www5.statcan.gc.ca/olc-cel/olc.action?objId=82-221-X&objType=2&lang=en&limit=0

Statistics Canada. (2018a). Adult and youth correctional statistics in Canada, 2016/2017. Retrieved from www150.statcan.gc.ca/n1/pub/85-002-x/2018001/article/54972-eng.htm

Statistics Canada. (2018b). National cannabis survey, third quarter of 2018. *Components of Statistics Canada Catalogue No. 11-001–X: Canadian Social Trends.*

Steele, C. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist*, *52*, 613–629.

Steele, C. M., & Josephs, R. A. (1990). Alcohol myopia: Its prized and dangerous effects. *American Psychologist*, *45*, 921–933.

Steele, J. D., Christmas, D., Eliamel, M. S., & Matthews, K. (2008). Anterior cingulotomy for major depression: Clinical outcome and relationship to lesion characteristics. *Biological Psychiatry*, *63*, 670–677.

Steffen, P. R., McNeilly, M., Anderson, N., & Sherwood, A. (2003). Effects of perceived racism and anger inhibition on ambulatory blood pressure in African Americans. *Psychosomatic Medicine*, *65*, 746–750.

Steinberg, L. (2004). Risk taking in adolescence: What changes, and why? *Annals of the New York Academy of Sciences*, *1021*, 51–58.

Steinberg, L. (2007). Risk taking in adolescence: New perspectives from brain and behavioral science. *Current Directions in Psychological Science*, *16*, 55–59.

Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, *28*, 78–106.

Steptoe, A., Lipsey, Z., & Wardle, J. (1998). Stress, hassles and variations in alcohol consumption, food choice and physical exercise: A dairy study. *British Journal of Health Psychology*, *3*, 51–63.

Sterling, P. (2011). Allostasis: A model of predictive regulation. *Physiology & Behavior*, *106*, 5–15.

Sternberg, R. J. (1983). Components of human intelligence. *Cognition*, *15*, 1–48.

Sternberg, R. J. (1988). *The triarchic mind: A new theory of human intelligence*. New York: Penguin Books.

Sternberg, R. J. (2003). Intelligence. In I. B. Weiner & D. K. Freedheim (Eds.), *Comprehensive handbook of psychology*, Vol. 1. New York: Wiley.

Sternberg, R. J., Castejón, J. L., Prieto, M. D., Hautamäki, J., & Grigorenko, E. L. (2001). Confirmatory factor analysis of the Sternberg Triarchic Abilities Test in three international samples: An empirical test of the triarchic theory of intelligence. *European Journal of Psychological Assessment*, *17*, 1–16.

Sternberg, R. J., Wagner, R. K., Williams, W. M., & Horvath, J. A. (1995). Testing common sense. *American Psychologist*, *60*, 46–59.

Stettler, N., Signer, T., & Paolo, S. (2004). Electronic games and childhood obesity. *Nutrition Research Newsletter*, *23*, 7–8.

Stevenson, R. A., Schlesinger, J. J., & Wallace, M. T. (2013). Effects of divided attention and operating room noise on perception of pulse oximeter pitch changes: A laboratory study. *Anesthesiology*, *118*, 376–381.

Stevenson, R. J., Oaten, M. J., Caste, T. I., Repacholi, B. M., & Wagland, P. (2010). Children's response to adult disgust elicitors: Development and acquisition. *Developmental Psychology*, *46*, 165–177.

Stewart, T. L., Latu, I. M., Kawakami, K., & Myers, A. C. (2010). Consider the situation: Reducing automatic stereotyping through Situational

Attribution Training. *Journal of Experimental Social Psychology*, *46*, 221–225.

Stice, E. (1998). Relations of restraint and negative affect to bulimic pathology: A longitudinal test of three competing models. *International Journal of Eating Disorders*, *23*, 243–260.

Stice, E., & Shaw, H. E. (1994). Adverse effects of the media portrayed thin-ideal on women and linkages to bulimic symptomatology. *Journal of Social and Clinical Psychology*, *13*, 288–308.

Stice, E., Presnell, K., Shaw, H., & Rohde, P. (2005). Psychological and behavioral risk factors for obesity onset in adolescent girls: A prospective study. *Journal of Consulting and Clinical Psychology*, *73*, 195–202.

Stice, E., Spoor, S., Bohon, C., Veldhuizen, M. G., & Small, D. M. (2008). Relation of reward from food intake and anticipated food intake to obesity: A functional magnetic resonance imaging study. *Journal of Abnormal Psychology*, *117*, 924–935.

Stickgold, R., LaTanya, J., & Hobson, A. (2000). Visual discrimination learning requires sleep after training. *Nature Neuroscience*, *3*, 1237–1238.

Stickgold, R., Scott, L., Rittenhouse, C., & Hobson, J. A. (1999). Sleep-induced changes in associative memory. *Journal of Cognitive Neuroscience*, *11*, 182–193.

Stigler, S. (2008). Fisher and the 5% level. *Chance*, *21*, 12.

Stillman, R. C., Weingartner, H., Wyatt, R. J., Gillin, J. C., & Eich, J. (1974). State-dependent (dissociative) effects of marihuana on human memory. *Arch Gen Psychiatry*, *31*, 81–85.

Stine-Morrow, E. A. L. (2007). The Dumbledore Hypothesis of cognitive aging. *Current Directions in Psychological Science*, *16*, 289–293.

Stinson, F. S., Dawson, D. A., Patricia Chou, S., Smith, S., Goldstein, R. B., ... & Grant, B. F. (2007). The epidemiology of DSM-IV specific phobia in the USA: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Psychological Medicine*, *37*, 1047–1059.

Stokoe, W. C., Casterline, D. C., & Croneberg, C. G. (1976). *A dictionary of American Sign Language on linguistic principles* (2nd ed.). Silver Spring, MD: Linstok Press.

Stolp, H. B., Tumquist, C., Dziegielewska, K. M., Saunders, N., Anthony, D. C., & Molnar, Z. (2011). Reduced ventrical proliferation in the foetal cortex following maternal inflammation in the mouse. *Brain*, *134*, 3236–3248.

Stoodley, C. J., & Schmahmann, J. D. (2010). Evidence for topographic organization in the cerebellum of motor control versus cognitive and affective processing. *Cortex*, *46*, 831–844.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology*, *54*, 768–777.

Strahan, E. J., Lafrance, A., Wilson, A. E., Ethier, N., Spencer, S. J., & Zanna, M. J. (2008). Victoria's dirty secret: How sociocultural norms influence adolescent girls and women. *Personality and Social Psychology Bulletin*, *34*, 288–301.

Strahan, E. J., Spencer, S. J., & Zanna, M. P. (2002). Subliminal priming and persuasion: Striking while the iron is hot. *Journal of Experimental Social Psychology*, *38*, 556–568.

Strahan, E. J., Wilson, A. E., Cressman, K. E., & Bruote, V. M. (2006). Comparing to perfection: How cultural norms for appearance affect social comparisons and self-image. *Body Image*, *3*, 211–227.

Strassman, R. (2001). *DMT: Spirit molecule*. Rochester, VT: Park Street Press.

Streissguth, A. P., & Connor, P. D. (2001). Fetal alcohol syndrome and other effects of prenatal alcohol: Developmental cognitive neuroscience implications. In C. A. Nelson & M. Luciana (Eds.), *Handbook of developmental cognitive neuroscience* (pp. 505–518). Cambridge, MA: MIT Press.

Strenziok, M., Krueger, F., Deshpande, G., Lenroot, R.K., van der Meer, E., & Grafman, J. (2011). Fronto-parietal regulation of media

violence exposure in adolescents: A multi-method study. *Social, Cognitive, and Affective Neuroscience*, *6*, 537–547.

Streppel, M. T., Boshuizen, H. C., Ocke, M. C., Kok, F. J., & Kromhout, D. (2007). Mortality and life expectancy in relation to long-term cigarette, cigar, and pipe smoking: The Zutphen study. *Tobacco Control*, *16*, 107–113.

Strickhouser, J. E., Zell, E., & Krizan, Z. (2017). Does personality predict health and well-being?: A metasynthesis. *Health Psychology*, *36*, 797–810.

Stroman, P. W. (2005). Magnetic resonance imaging of neuronal function in the spinal cord: Spinal FMRI. *Clinical Medicine & Resesarch*, *3*, 141–156.

Strome, E. M., Wheler, G. H. T., Higley, J. D., Loriaux, D. L., Suomi, S. J., & Doudet, D. J. (2002). Intracerebroventricular corticotropin-releasing factor increases limbic glucose metabolism and has social context-dependent behavioral effects in nonhuman primates. *Proceedings of the National Academy of Science of the United States of America*, *99*, 15749–15754.

Stuart, E. W., Shimp, T. A., & Engle, R. W. (1990). Classical conditioning of negative attitudes. *Advances in Consumer Research*, *17*, 536–540.

Stuber, G. D., & Wise, R. A. (2016). Lateral hypothalamic circuits for feeding and reward. *Nature Neuroscience*, *19*, 198–2015.

Stürmer, S., Snyder, M., & Omoto, A. M. (2005). Prosocial emotions and helping: The moderating role of group membership. *Journal of Personality and Social Psychology*, *88*, 532–546.

Stuss, D. T. (2011). Functions of the frontal lobes: Relation to executive functions. *Journal of the International Neuropsychological Society*, *17*, 759–765.

Stuss, D. T., & Knight, R. T. (2002). *Principles of frontal lobe function*. New York: Oxford University Press.

Sue, S., & Lam, A. G. (2002). Cultural and demographic diversity. In J. C. Norcross (Ed.), *Psychotherapy relationships that work: Therapist contributions and responsiveness to patients* (pp. 401–422). New York: Oxford University Press.

Sumnall, H. R., Measham, F., Brandt, S. D., & Cole, J. C. (2011). Salvia divinorum use and phenomenology: Results from an online survey. *Journal of Psychopharmacology*, *25*, 1496–1507.

Supreme Court of Canada. (2001). *R. v. Sharpe*, [2001] 1 S.C.R. 45, 2001 SCC 2.

Supreme Court of Canada. (2004). *Canadian Foundation for Children, Youth and the Law v. Canada (Attorney General*), [2004] 1 S.C.R. 76, 2004 SCC 4.

Supreme Court of Canada. (2007). *R. v. Trochym*, [2007] 1 S.C.R., 2007 SCC 239.

Supreme Court of Canada. (2015). *R. v. Campione*, 2015 O.N.C.A. 67 (CanLII).

Susser, E., Neugebauer, R., Hoek, H. W., Brown, A. S., Lin, S., ... Gorman, J. M. (1996). Schizophrenia after prenatal famine: Further evidence. *Archives of General Psychiatry*, *53*, 25–31.

Susskind, J. M., & Anderson, A. K. (2008). Facial expression form and function. *Nature Neuroscience*, *11*, 843–850.

Sutherland, R., & Hayne, H. (2001). The effect of postevent information on adults' eyewitness reports. *Applied Cognitive Psychology*, *15*, 249–263.

Suzuki, A., Honma, Y., & Suga, S. (2013). Indelible distrust: Memory bias toward cheaters revealed as high persistence against extinction. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*, 1901–1913.

Suzuki, H., Uchiyama, M., Tagaya, H., Ozaki, A., Kuriyama, K., ... Kuga, R. (2004). Dreaming during non-rapid eye movement sleep in the absence of prior rapid eye movement sleep. *Sleep*, *27*, 1486–1490.

Swaab, D. F., & Garcia-Falgueras, A. (2009). Sexual differentiation of the human brain in relation to gender identity and sexual orientation.

Functional Neurology, *24*, 17–28.

Sweeney, P. D., Anderson, K., & Bailey, S. (1986). Attributional style in depression: A meta-analytic review. *Journal of Personality and Social Psychology*, *50*, 974.

Swire, B., Ecker, U. K. H., & Lewandowsky, S. (2017). The role of familiarity in correcting inaccurate information. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *43*, 1948–1961.

Sylva, D., Safron, A., Rosenthal, A. M., Reber, P. J., Parrish, T., B., & Bailey, J. M. (2013). Hormones and behavior neural correlates of sexual arousal in heterosexual and homosexual women and men. *Hormones and Behavior*, *64*, 673–684.

Symons, C. S., & Johnson, B. T. (1997). The self-reference effect in memory: A meta-analysis. *Psychological Bulletin*, *121*, 371–394.

Szelenberger, W., Niemcewicz, S., & Dabrowska, A. J. (2005). Sleepwalking and night terrors: Psychopathological correlates. *International Review of Psychology*, *17*, 263–270.

Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American*, *223*, 96–102.

Tajfel, H., & Turner, J. C. (1986). The social identity theory of intergroup behaviour. In S. Worchel & W. G. Austin (Eds.), *Psychology of*

intergroup relations (2nd ed., pp. 7–24). Chicago: Nelson-Hall.

Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, *1*, 149–178.

Takahashi, T., Zhou, S. Y., Nakamura, K., Tanino, R., Furuichi, A., ... Suzuki, M. (2011). A follow-up MRI study of the fusiform gyrus and middle and inferior temporal gyri in schizophrenia spectrum. *Progress in Neuropsychopharmacology and Biological Psychiatry*, *35*, 1957–1964.

Takahashi, Y. (1990). Is multiple personality really rare in Japan? *Dissociation*, *3*, 57–59.

Takeuchi, D., & Cheung, M. (1998). Coercive and voluntary referrals: How ethnic minority adults get into mental health treatment. *Ethnicity & Health*, *3*, 149–158.

Talarico, J., & Rubin, D. (2003). Confidence, not consistency, characterizes flashbulb memories. *Psychological Science*, *14*, 455–461.

Talmi, D., Grady, C., Goshen-Gottstein, Y., & Moscovitch, M. (2005). Neuroimaging the serial position curve: A test of single-store versus dual-store models. *Psychological Science*, *16*, 716–723.

Tanaka, J. W., & Farah, M. J. (1993). Parts and wholes in face recognition. *The Quarterly Journal of Experimental Psychology*, *46A*, 225–245.

Tang, Y. (2011). Mechanisms of integrative body-mind training. *Neuroscience Bulletin*, *27*, 383–388.

Tang, Y., Hölzel, B. K., & Posner, M. I. (2015). The neuroscience of mindfulness meditation. *Nature Reviews Neuroscience*, *16*, 213–225.

Tang, Y., Lu, Q., Geng, X., Stein, E. A., Yang, Y., & Posner, M. I. (2010). Short-term meditation induces white matter changes in the anterior cingulate. *Proceedings of the National Academy of Sciences of the USA*, *107*, 15649–15652.

Tang, Y., Ma, Y., Fan, Y., Feng, H., Wang, J., Feng, S., et al. (2009). Central and autonomic nervous system interaction is altered by short-term meditation. *Proceedings of the National Academy of Sciences*, *106*, 8864–8870.

Tang, Y., Ma., Y., Wang, J., Fan, Y., Feng, S., Lu, Q., et al. (2007). Short-term meditation training improves attention and self-regulation. *Proceedings of the National Academy of Science of the United States of America*, *104*, 17152–17156.

Tang, Y., Shimizu, E., Dube, G. R., Rampon, C., Kerchner, ... Tsien, J. Z. (1999). Genetic enhancement of learning and memory in mice. *Nature*, *401*, 63–69.

Tangney, J. P., & Dearing, R. L. (2002). *Shame and guilt*. New York: Guilford Publications.

Tarver, J., Daley, D., & Sayal, K. (2014). Attention-deficit hyperactivity disorder (ADHD): An updated review of the essential facts. *Child: Care, Health, and Development*, *40*, 762–775.

Tascioglu, A. B. (2005) Brief review of vestibular system anatomy and its higher order projections. *Neuroanatomy*, *4*, 24–27.

Tashiro, A., Hiroshi, M., & Gage, F. H. (2007). Experience-specific functional modification of the dentate gyrus through adult neurogenesis: A critical period during an immature stage. *Journal of Neuroscience*, *27*, 3252–3259.

Taylor, A. J., & Hort, J. (2004). Measuring proximal stimuli involved in flavour perception. In A. J. Taylor & D. R. Roberts (Eds.), *Flavor perception* (pp. 1–38). Oxford, UK: Blackwell.

Taylor, S. E. (2006). Tend and befriend: Biobehavioral bases of affiliation under stress. *Current Directions in Psychological Science*, *15*, 273–277.

Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A., & Updegraff, J. A. (2000). Biobehavioral responses to stress in females: Tend-and-befriend, not fight-or-flight. *Psychological Review*, *107*, 411–429.

TED. (2019). Your body language may shape who you are. Retrieved from www.ted.com/talks/amy_cuddy_your_body_language_shapes_who_you_are

Tedeschi, R. G., & Calhoun, L. G. (2004). Post-traumatic growth: Conceptual foundations and empirical evidence. *Psychological Inquiry*, *15*, 1–18.

Tedesco, J. C., & Dunn, S. W. (2018). Political advertising in the 2016 U.S. presidential election: Ad hominem ad nauseam. *American Behavioral Scientist*, *63*, 935–947.

Tellegen, A., Lykken, D. T., Bouchard, T. J., Wilcox, K. J., Segal, N. L., & Rich, S. (1998). Personality similarity in twins reared apart and together. *Journal of Personality and Social Psychology*, *54*, 1031–1039.

Teplin, L. A., McClelland, G. M., Abram, K. M., & Weiner, D. A. (2005). Crime victimization in adults with severe mental illness: Comparison with the National Crime Victimization Survey. *Archives of General Psychiatry*, *62*, 911–921.

Terao, Y. & Ugawa, Y. (2002). Basic mechanisms of TMS. *Journal of Clinical Neurophysiology*, *19*, 322–343.

Terman, L. M. (1916). *The uses of intelligence tests*. Boston: Houghton Mifflin.

Terracciano, A., Abdel-Khalek, A. M., Adám, N., et al. (2005). National character does not reflect mean personality trait levels in 49 cultures. *Science*, *310*, 96–100.

Terracciano, A., Sanna, S, Uda, M., Deiana, B., Usala, G., Busonero, F., ... Costa, P. T., Jr. (2010). Genome-wide association scan for five major dimensions of personality. *Molecular Psychiatry*, *15*, 647–656.

Thanarajah, S. E., Backes, H., DiFeliceantonio, A. G., Albus, K., Cremer, A., L., ... Tittgemeyer, M. (2018). Food intake recruits orosensory and post-ingestive dopaminergic circuits to affect eating desire in humans. *Cell Metabolism*, *29*, 695–706.

Thase, M. E., & Denko, T. (2008). Pharmacotherapy of mood disorders. *Annual Review of Clinical Psychology*, *4*, 53–91.

The Economist. (2018, October 15). After a year of #MeToo, American opinion has shifted against victims. *The Economist*. Retrieved from www.economist.com/graphic-detail/2018/10/15/after-a-year-of-metoo-american-opinion-has-shifted-against-victims

Thoinot, L. (1913). *Medicolegal aspects of moral offenses*. A. W. Weysse (translator). Philadelphia: F. A. Davis and Company Publishers.

Thomas, A., & Chess, S. (1977). *Temperament and development*. New York: Brunder/Mazel.

Thompson, A. E., O'Sullivan, L. F., Byers, E. S., & Shaughnessy, K. (2014). Young adults' implicit and explicit attitudes towards the sexuality of older adults. *Canadian Journal on Aging*, *33*, 259–270.

Thompson, W. C., Clarke-Stewart, A., & Lepore, S. J. (1997). What did the janitor do?: Suggestive interviewing and the accuracy of children's accounts. *Law and Human Behavior*, *21*, 405–426.

Thompson, W. F., Russo, F. A., & Quinto, L. (2008). Audio-visual integration of emotional cues in song. *Cognition and Emotion*, *22*, 1457–1470.

Thorndike, E. L. (1905). *The elements of psychology*. New York: Seiler.

Thornton, A., & Raihani, N. J. (2010). Identifying teaching in wild animals. *Learning & Behavior*, *38*, 297–309.

Thurstone, L. L. (1938). *Primary mental abilities*. Chicago: University of Chicago Press.

Tinbergen, N. (1989). *The Study of Instinct*. Oxford, U.K.: Clarendon Press.

Tine, M. (2014). Working memory differences between children living in rural and urban poverty. *Journal of Cognition and Development*, *15*, 599–613.

Tirri, K., & Nokelainen, P. (2008). Identification of multiple intelligences with the Multiple Intelligence Profiling Questionnaire III. *Psychology*

Science, *50*, 206–221.

Titchener, E. B. (1898). The postulates of structural psychology. *Philosophical Review*, *7*, 449–465.

Titov, N., Andrews, G., Davies, M., McIntyre, K., Robinson, E., & Solley, K. (2010). Internet treatment for depression: A randomized controlled trial comparing clinician vs. technician assistance. *PLoS ONE*, *5*, e10939.

Tobias, M. C., O'Neill, J., Hudkins, M., Bartzokis, G., Dean, A. C., & London, E. D. (2010). White-matter abnormalities in brain during early abstinence from methamphetamine abuse. *Psychopharmacology*, *209*, 13–24.

Tobin, S. J., Vanman, E. J., Verreynne, M., & Saeri, A. K. (2014). Threats to belonging on Facebook: Lurking and ostracism. *Social Influence*, *10*, 31–42.

Tobler, I., Kopp, C., Deboer, T., Rudolph, U. (2001). Diazepam-induced changes in sleep: Role of the a1 GABAA receptor subtype. *Proceedings of the National Academy of Sciences*, *98*, 6464–6469.

Tochigi, M., Okazaki, Y., Kato, N., & Sasaki, T. (2004). What causes seasonality of birth in schizophrenia? *Neuroscience Research*, *48*, 1–11.

Todman, D. (2008). Wilder Penfield. *Journal of Neurology, Neurosurgery, & Psychiatry*, *255*, 1104–1105.

Todorov, A., Mandisodza, A. N., Goren, A., & Hall, C. (2005). Inferences of competence from faces predict election outcomes. *Science*, *308*, 1623–1626.

Tolman, E. C., & Honzik, C. H. (1930). Degrees of hunger, reward and non-reward, and maze learning in rats. *University of California Publications in Psychology*, *4*, 4241–4256.

Tom, G., Tong, S. T., & Hesse, C. (2010). Thick slice and thin slice teaching evaluations. *Social Psychology of Education: An International Journal*, *13*, 129–136.

Tomblin, J. B., O'Brien, M., Shriberg, L. D., Williams, C., Murray, J., Patil, S., et al. (2009). Language features in a mother and daughter of a chromosome 7;13 translocation involving FOXP2. *Journal of Speech, Language, and Hearing Research*, *52*, 1157–1174.

Toppo, G. (2018, June 20). Time to dismiss the Stanford Prison Experiment? *Inside Higher Ed*. Retrieved from www.insidehighered.com/news/2018/06/20/new-stanford-prison-experiment-revelations-question-findings

Torgersen, S., Lygren, S., Oien, P. A., Skre, I., Onstad, S., ... Kringlen, E. (2000). A twin study of personality disorders. *Comprehensive Psychiatry*, *41*, 416–425.

Tottenham, L. S., Saucier, D. M., Elias, L. J., & Gutwin, C. (2005). Men are more accurate than women in aiming at targets in both near space and extrapersonal space. *Perceptual and Motor Skills*, *101*, 3–12.

Townsend, J. M., & Levy, G. D. (1990a). Effects of potential partners' costume and physical attractiveness on sexuality and partner selection. *Journal of Psychology*, *124*, 371–389.

Townsend, J. M., & Levy, G. D. (1990b). Effects of potential partners' physical attractiveness and socioeconomic status on sexuality and partner selection: Sex differences in reported preferences of university students. *Archives of Sexual Behavior*, *19*, 149–164.

Tracy, M., Zimmerman, F. J., Galea, S., McCauley, E., & Stoep, A. V. (2008). What explains the relation between family poverty and childhood depressive symptoms? *Journal of Psychiatric Research*, *42*, 1163–1175.

Trainor, L. J. (2010). Using electroencephalography (EEG) to measure maturation of auditory cortex in infants: Processing pitch, duration and sound location. In R. E. Trembley, R. G. Barr, RDeV. Peters, & M. Bovin (Eds.), *Encyclopedia on early childhood development*. Montreal, QC: Centre of Excellence for Early Childhood Development.

Trainor, L. J., McFadden, M., Hodgson, L., Darragh, L., Barlow, J., Matsos, L., & Sonnadara, R. (2003). Changes in auditory cortex and the

development of mismatch negativity between 2 and 6 months of age. *International Journal of Psychophysiology*, *51*, 5–15.

Tranel, D., Damasio, H., & Damasio, A. R. (1997). A neural basis for the retrieval of conceptual knowledge. *Neuropsychologia 35*, 1319–1327.

Tremblay, P., & Dick, A. S. (2016). Broca and Wernicke are dead, or moving past the classic model of language neurobiology. *Brain & Language*, *162*, 60–71.

Triplett, N. (1898). The dynamogenic factors in pacemaking and competition. *The American Journal of Psychology*, *9*, 507–533.

Trivers, R. L. (1972). Parental investment and sexual selection. In B. Campbell (Ed.), *Sexual selection and the descent of man*: *1871–1971* (pp. 136–179). Chicago, IL: Aldine.

Trofimova, I., & Robbins, T. (2016). Temperament and arousal systems: A new synthesis of differential psychology and functional neurochemistry. *Neuroscience and Biobehavioral Reviews*, *64*, 382–402.

Troje, N. F. (2002a). Decomposing biological motion: A framework for analysis and synthesis of human gait patterns. *Journal of Vision*, *2*, 371–387.

Troje, N. F. (2002b). The little difference: Fourier based gender classification from biological motion. In R.P. Wurtz & M. Lappe

(Eds.), *Dynamic perception*. Berlin: Aka Press.

Troje, N. F. (2008). Retrieving information from human movement patterns. In T. F. Shipley & J. M. Zacks (Eds.), *Understanding events: How humans see, represent, and act on events* (pp. 308–334). New York: Oxford University Press.

Troop, N. A. (1998). Eating disorders as coping strategies: A critique. *European Eating Disorders Review*, *6*, 229–237.

Trope, Y., & Liberman, N. (2010). Construal-level theory of psychological distance. *Psychological Review*, *117*, 440–463.

Tropp, L. R., & Pettigrew, T. F. (2005). Relationships between intergroup contact and prejudice among minority and majority status groups. *Psychological Science*, *16*, 951–957.

Troseth, G. L. (2010). Is it life or is it Memorex? Video as a representation of reality. *Developmental Review*, *30*, 155–175.

Tschacher, W., Rees, G. M., & Ramseyer, F. (2014). Nonverbal synchrony and affect in dyadic interactions. *Frontiers in Psychology*, *5*, 1323.

Tse, D., Takeuchi, T., Kakeyama, M., Kajii, Y., Okuno, H., Tohyama, C., et al. (2011). Schema-dependent gene activation and memory encoding in neocortex. *Science*, *333*, 891–895.

Tsuchiya, N., Moradi, F., Felsen, C., Yamazaki, M., & Adolphs, R. (2009). Intact rapid detection of fearful faces in the absence of the amygdala. *Nature Neuroscience*, *12*, 1224–1225.

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving & W. Donaldson (Eds.), *Organization of memory* (pp. 381–402). New York: Academic Press.

Tulving, E. (1974). Cue-dependent forgetting. *American Scientist*, *62*, 74–82.

Tulving, E., & Markowitsch, H. J. (1998). Episodic and declarative memory: Role of the hippocampus. *Hippocampus*, *8*, 198–203.

Tulving, E., & Thompson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review*, *80*, 352–373.

Tulving, E., & Watkins, M. J. (1975). Structure of memory traces. *Psychological Review*, *82*, 261–275.

Tulving, E., Kapur, S., Craik, F. I. M., Moscovitch, M., & Houle, S. (1994). Hemispheric encoding/retrieval asymmetry in episodic memory: Positron emission tomography findings. *Proceedings of the National Academy of Sciences*, *91*, 2016–2020.

Tulving, E., Schacter, D. L., McLachlan, D. R., & Moscovitch, M. (1988). Priming of semantic autobiographical knowledge: A case study of retrograde amnesia. *Brain and Cognition*, *8*, 3–20.

Tulving, E., Schacter, D. L., & Stark, H. A. (1982). Priming effects in word-fragment completion are independent of recognition memory. *Journal of Experimental Psychology*, *8*, 336–342.

Tupper, K. W., Wood, E., Yensen, R., & Johnson, M. W. (2015). Psychedelic medicine: A re-emerging therapeutic paradigm. *Canadian Medical Association Journal*, *187*, 1054–1059.

Turk, C., Heimberg, R., Luterek, J., Mennin, D., & Fresco, D. (2005). Emotion dysregulation in generalized anxiety disorder: A comparison with social anxiety disorder. *Cognitive Therapy and Research*, *29*, 89–106.

Turkheimer, E., Haley, A., Waldron, M., D′Onofrio, B., & Gottesman, I. I. (2003). Socioeconomic status modifies heritability of IQ in young children. *Psychological Science*, *14*, 623–628.

Turner, D. C., Robbins, L. C., Aron, A. R., Dowson, J., & Sahakian, B. J. (2003). Cognitive enhancing effects of modafinil in healthy volunteers. *Psychopharmacology*, *165*, 260–269.

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*, 207–232.

Tversky, A., & Kahneman, D. (1982). The framing of decisions and the psychology of choice. *Science*, *211*, 453–458.

Twenge, J. M., Campbell, W. K., & Foster, C. A. (2003). Parenthood and marital satisfaction: A meta-analytic review. *Journal of Marriage and Family*, *65*, 574–583.

Uchimura, N. & North, R. A. (1990). Actions of cocaine on rat nucleus accumbens neurones in vitro. *British Journal of Pharmacology*, *99*, 736–740.

Ungerleider, L. G., & Mishkin, M. (1982). Object vision and spatial vision: Two cortical pathways. In D. J. Ingle, M. A. Goodale, & R. J. W. Mansfield (Eds.), *Analysis of visual behaviour* (pp. 296–302). Cambridge, MA: MIT Press.

United States Department of Health and Human Services (USDHHS). (2001). *Mental health: Culture, race, and ethnicity—A supplement to Mental Health: A Report of the Surgeon General*. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Office of the Surgeon General.

United States Department of Justice. (2001). *Policing and homicide, 1976–98: Justifiable homicide by police, police officers murdered by felons* (NCJ180987). Washington, DC: Bureau of Justice Statistics.

University of New Hampshire. (2012). Unwanted sexual experiences at UNH: 2012 Study and changes over time. Retrieved from https://cola.unh.edu/sites/default/files/media/2018/10/unwanted-sexual-experiences-unh.pdf

Uno, Y., & Coyle, J. T. (2019). Glutamate hypothesis in schizophrenia. *Psychiatry and Clinical Neurosciences*, *73*, 204–215.

Upton, N. (1994). Mechanisms of action of new antiepileptic drugs: Rational design and serendipitous finding. *Trends in Pharmacological Science*, *15*, 456–463.

Urban, N. B., Girgis, R. R., Talbot, P. S., Kegeles, L. S., Xu, X., ... Laruelle, M. (2012). Sustained recreational use of ecstasy is associated with altered pre and postsynaptic markers of serotonin transmission in neocortical areas: A PET study with [11C]DASB and [11C]MDL 100907. *Neuropsychopharmacology*, *37*, 1465–1473.

Uziel, L. (2007). Individual differences in the social facilitation effect: A review and meta-analysis. *Journal of Research in Personality*, *41*, 579–601.

Valenstein, E. A. (1997). History of psychosurgery. In S. H. Greenblatt (Ed.), *A history of neurosurgery in its scientific and professional contexts* (pp. 499–516). Park Ridge, IL: The American Association of Neurological Surgeons.

Valenstein, E. S. (1973). *Brain control: A critical examination of brain stimulation and psychosurgery*. London: Wiley-Interscience.

Valentin, V., & O'Doherty, J. P. (2009). Overlapping prediction errors in dorsal striatum during instrumental learning with juice and money reward in the human brain. *Journal of Neurophysiology*, *102*, 3384–3391.

Van den Bussche, E., Van den Noortgate, W., & Reynvoet, B. (2009). Mechanisms of masked priming: A meta-analysis. *Psychological Bulletin*, *135*, 452–477.

van der Kolk, B. A. (1994). The body keeps score: Memory and the evolving psychobiology of posttraumatic stress. *Harvard Review of Psychiatry*, *1*, 253–265.

van Honk, J., Tuiten, A., Hermans, E., Putman, P., Koppeschaar, H., Thijssen, J., ... van Doornen, L. (2001). A single administration of testosterone induces cardiac accelerative responses to angry faces in healthy young women. *Behavioral Neuroscience*, *115*, 238–242.

Van Iddekinge, C. H., Aguinis, H., Mackey, J. D., & DeOrtentiis, P. S. (2018). A meta-analysis of the interactive, additive, and relative effects of cognitive ability and motivation on performance. *Journal of Management*, *44*, 249–279.

van Kesteren, M. T. R., Fernandez, G., Norris, D. G., & Hermans, E. J. (2010). Persistent schema-dependent hippocampal-neocortical connectivity during memory encoding and postencoding rest in humans. *Proceedings of the National Academy of Sciences*, *107*, 7550–7555.

van Kesteren, M. T. R., Rijpkema, M., Ruiter, D. J., & Fernandez, G. (2010). Retrieval of associative information congruent with prior knowledge is related to increased medial prefrontal activity and connectivity. *Journal of Neuroscience*, *30*, 15888–15894.

Van Leeuwen, E. J., Cronin, K. A., & Haun, D. B. M. (2014). A group-specific arbitrary tradition in chimpanzees (*Pan troglodytes*). *Animal Cognition*, *17*, 1421–1425.

Van Oort, F. V. A., Greaves-Lord, K., Verhulst, F. C., Ormel, J., & Huizink, A. C. (2009). The developmental course of anxiety symptoms during adolescence: The TRAILS study. *Journal of Child Psychology and Psychiatry*, *50*, 1209–1217.

van Praag, H. (2008). Neurogenesis and exercise: Past and future directions. *Neuromolecular Medicine*, *10*, 128–140.

van Praag, H. (2009). Exercise and the brain: Something to chew on. *Trends in Neuroscience*, *32*, 283–290.

van Straten, A., & Cuijpers, P. (2009). Self-help therapy for insomnia: A meta-analysis. *Sleep Medicine Reviews*, *13*, 61–71.

Vanheusden, K., Mulder, C. L., van der Ende, J., van Lenthe, F. J., et al. (2008). Young adults face major barriers to seeking help from mental health services. *Patient Education and Counseling 73*, 97–104.

Vansteenkiste, M., Lens, W., & Deci, E. L. (2006). Intrinsic versus extrinsic goal contents in self-determination theory: Another look at the quality of academic motivation. *Educational Psychology*, *41*, 19–31.

Vargha-Khadem, F., Gadian, D. G., Copp, A., & Mishkin, M. (2005). FOXP2 and the neuroanatomy of speech and language. *Nature Reviews Neuroscience*, *6*, 131–138.

Veling, W., Selten, J., Veen, N., Laan, W., Blom, J. D., & Hoek, H. W. (2006). Incidence of schizophrenia among ethnic minorities in the Netherlands: A four-year first-contact study. *Schizophrenia Research*, *86*, 189–193.

Vervaeke, J., & Ferraro, L. (2012). Relevance, meaning, and the cognitive science of wisdom. In M. Ferrari and N. Westrate (Eds.), *The scientific study of personal wisdom: From contemplative traditions to neuroscience*. New York: Springer.

Verwey, M., & Amir, S. (2009). Food-entrainable circadian oscillators in the brain. *European Journal of Neuroscience*, *30*, 1650–1657.

Villar, J., Merialdi, M., Gülmezoqlu, A. M., Abalos, E., Carroli, G., ... de Onis, M. (2003). Characteristics of randomized controlled trials included in systematic reviews of nutritional interventions reporting maternal morbidity, mortality, preterm delivery, intrauterine growth restriction and small for gestational age and birth weight outcomes. *Journal of Nutrition*, *133*, 1632–1639.

Virdee, K., Cumming, P., Caprioli, D., Jupp, B., Rominger, A., Aigbirhio, F. I., et al. (2012). Applications of positron emissions tomography in animal models of neurological and neuropsychiatric disorders. *Neuroscience and BioBehavioral Reviews*, *36*, 1188–1216.

Vittner, D., McGrath, J., Robinson, J., Lawhon, G., Cusson, R., … Cong, X. (2018). Increase in oxytocin from skin-to-skin contact enhances development of parent-infant relationship. *Biological Research for Nursing*, *20*, 54–62.

Voelker, R. (2003). Mounting student depression taxing campus mental health services. *Journal of the American Medical Association*, *289*, 2055–2056.

Vogel, D. L., Wade, N. G., & Ascheman, P. (2009). Measuring perceptions of stigmatization by others for seeking psychological help: Reliability and validity of a new stigma scale with college students. *Journal of Counseling Psychology*, *56*, 301–308.

Vogel, E., Woodman, G., & Luck, S. (2001). Storage of features, conjunctions, and objects in visual working memory. *Journal of Experimental Psychology: Human Perception and Performance*, *27*, 92–114.

Vohr, B. R., Davis, E. P., Wanke, C. A., & Krebs, N. F. (2017). Neurodevelopment: The impact of nutrition and inflammation during preconception and pregnancy in low-resource settings. *Pediatrics*, *139* (Supplement 1) S38–S49. doi 10.1542/peds.2016-2828F.

Vohs, K. D., Bardone, A. M., Joiner, T. E., & Abramson, L. Y. (1999). Perfectionism, perceived weight status, and self-esteem interact to predict bulimic symptoms: A model of bulimic symptoms development. *Journal of Abnormal Psychology*, *108*, 695–700.

Vokey, J. R., & Read, J. D. (1985). Subliminal messages. *American Psychologist*, *40*, 1231–1239.

Volkow, N. D., & Morales, M. (2015). The brain on drugs: From reward to addiction. *Cell*, *162*, 712–725.

Volkow, N. D., Fowler, J. S., Wang, G. J., Baler, R., & Telang, F. (2009). Imaging dopamine's role in drug abuse and addiction. *Neuropharmacology*, *56 Supplement 1*, 3–8.

Volpe, J. J. (2008). Neurological examination: Normal and abnormal features. In J. J. Volpe (Ed.), *Neurology of the Newborn* (5th ed.). Philadelphia: Saunders Elsevier.

von Frisch, K. (1967). *The dance language and orientation of bees*. Cambridge, MA: Harvard University Press.

Vouloumanos, A., & Werker, J. F. (2004). Tuned to the signal: The privileged status of speech for young infants. *Developmental Science*, *3*, 270–276.

Voyer, D., Bowes, A., & Techentin, C. (2008). On the perception of sarcasm in dichotic listening. *Neuropsychology*, *22*, 390–399.

Voyer, D., Rodgers, M. A., & McCormick, P. A. (2004). Timing conditions and the magnitude of gender differences on the Mental Rotations Test. *Memory & Cognition*, *32*, 72–82.

Vuilleumier, P. (2005). How brains beware: Neural mechanisms of emotional attention. *Trends in Cognitive Sciences*, *9*, 585–592.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Wade, K. A., Garry, M., Read, J. D., & Lindsay, D. S. (2002). A picture is worth a thousand lies: Using false photographs to create false childhood memories. *Psychonomic Bulletin & Review*, *9*, 597–603.

Wadzinski, J., Franks, R., Roane, D., & Bayard, M. (2007). Valproate-associated hyperammonemic encephalopathy. *Journal of the American Board of Family Medicine*, *20*, 499–502.

Wagar, B. M., & Thagard, P. (2004). Spiking Phineas Gage: A neurocomputational theory of cognitive-affective integration in decision making. *Psychological Review*, *111*, 67–69.

Wagenaar, W. A., & Groeneweg, J. (1990). The memory of concentration camp survivors. *Applied Cognitive Psychology*, *4*, 77–87.

Wagenmakers, E.-J., Beek, T., Dijkhoff, L., & Gronau, Q. F. (2016). Registered replication report: Strack, Martin, & Stepper (1988). *Perspectives on Psychological Science*, *11*, 917–928.

Wagner, A. D., Desmond, J. E., Glover, G. H., & Gabrieli, J. D. E. (1998). Prefrontal cortex and recognition memory: Functional-MRI

evidence for context-dependent retrieval processes. *Brain*, *121*, 1985–2002.

Wagner, G. A., & Morris, E. K. (1987). "Superstitious" behavior in children. *Psychological Record*, *37*, 471–488.

Wahba, M. A., & Bridwell, L. G. (1976). Maslow reconsidered: A review of research on the need hierarchy theory. *Organizational Behavior and Human Performance*, *15*, 212–240.

Wahlsten, D. (1997). Leilani Muir versus the philosopher king: Eugenics on trial in Alberta. *Genetica*, *99*, 185–198.

Wai, J., Cacchio, M., Putallaz, M., & Makel, M. C. (2010). Sex differences in the right tail of cognitive abilities: A 30 year examination. *Intelligence*, *38*, 412–423.

Waite, L. J., & Gallagher, M. (2000). *The case for marriage: Why married people are happier, healthier and better off financially*. New York: Doubleday.

Waitt, C., Gerald, M. S., Little, A. C., & Kraiselburd, E. (2006). Selective attention toward female secondary sexual color in male rhesus macaques. *American Journal of Primatology*, *68*, 738–744.

Wakefield, A. J., Murch, S. H., Anthony, A., Linnell, J., Casson, D. M., Malik, M., et al. (1998). Retracted: Ileal-lymphoid-nodular

hyperplasia, non-specific colitis, and pervasive developmental disorder in children. *The Lancet*, *351*, 637–641.

Walker, E. G., Savole, T., & Davis, D. (1994). Neuromotor precursors of schizophrenia. *Schizophrenia Bulletin*, *20*, 441–451.

Walker, E. G., Shapiro, D., Esterberg, M., & Trotman, H. (2010). Neurodevelopment and schizophrenia: Broadening the focus. *Current Directions in Psychological Science*, *19*, 204–208.

Walker, L. J., & Frimer, J. A. (2007). Moral personality of brave and caring exemplars. *Journal of Personality and Social Psychology*, *93*, 845–860.

Walker, L. J., Frimer, J. A., & Dunlop, W. L. (2010). Varieties of moral personality: Beyond the banality of heroism. *Journal of Personality*, *78*, 907–942.

Walker, M. P., Liston, C., Hobson, J. A., & Stickgold, R. (2002). Cognitive flexibility across the sleep-wake cycle: REM-sleep enhancement of anagram problem solving. *Cognitive Brain Research*, *14*, 317–324.

Walker, M., Al-Sahab, B., Islam, F., & Tamim, H. (2011). The epidemiology of alcohol utilization during pregnancy: An analysis of the Canadian Maternity Experiences Survey (MES). *BMC Pregnancy and Childbirth*, *11*, 52.

Wallace, L. E., Anthony, R., End, C. M., & Way, B. M. (2019). Does religion stave off the grave? Religious affiliation in one's obituary

and longevity. *Social Psychological and Personality Science*, *10*, 662–670.

Waller, G. P., & Hodgson, S. (1996). Body image distortion in anorexia and bulimia nervosa: The role of perceived and actual control. *Journal of Nervous & Mental Disease*, *184*, 213–219.

Walther, E., & Grigoriadis, S. (2004). Why sad people like shoes better: The influence of mood on the evaluative conditioning of consumer attitudes. *Psychology and Marketing*, *21*, 755–773.

Walum, H., Westerberg, L., Henningsson, S., Neiderhiser, J. M., Reiss, D., ... Lichtenstein, P. (2008). Genetic variation in vasopressin receptor 1a gene (AVPR1A) associated with pair-bonding behavior in humans. *Proceedings of the National Academy of Sciences*, *105*, 14153–14156.

Wampold, B. E. (2001). *The great psychotherapy debate: Model, methods, and findings*. Mahwah, NJ: Lawrence Erlbaum Associates.

Wang, P. S., Berglund, P., Olfson, M., Pincus, H. A., Wells, K. B., & Kessler, R. C. (2005). Failure and delay in initial treatment contact after first onset of mental disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, *62*, 603–613.

Wang, R., & Holsinger, R. M. D. (2018). Exercise-induced brain-derived neurotrophic factor expression: Therapeutic implications for Alzheimer's dementia. *Ageing Research Reviews*, *48*, 109–121

Wang, S. H., & Morris, R .G. (2010). Hippocampal-neocortical interactions in memory formation, consolidation, and reconsolidation. *Annual Review of Psychology*, *61*, 49–79.

Wang, X., Lu, T., Snider, R. K., & Liang, L. (2005). Sustained firing in auditory cortex evoked by preferred stimuli. *Nature*, *435*, 341–346.

Ward, C. D., & Cooper, R. P. (1999). A lack of evidence in 4-month-old human infants for paternal voice preference. *Developmental Psychobiology*, *35*, 49–59.

Ward, L. M., MacLean, S. E., & Kirschner, A. (2010). Stochastic resonance modulates neural synchronization within and between cortical sources. *PLoS One*, *5*, e14371.

Wardell, J. D., & Read, J. P. (2013). Does cue context matter? Examining the specificity of cue-related activation of positive and negative alcohol expectancies. *Experimental and Clinical Psychopharmacology*, *21*, 457–466.

Ware, M. A., Wang, T., Shapiro, S., Robinson, A., Dubruet, T., ... Collet, J. (2010). Smoked cannabis for chronic neuropathic pain: A randomized controlled trial. *Canadian Medical Association Journal*, *182*, E694–E701.

Warfield, D. (1973). The study of hearing in animals. In Gray, W. (Ed.), *Methods of Animal Experimentation* (Vol. IV, pp. 43–143). London: Academic Press.

Warren, C., & McGraw, A.P. (2015). What makes things humorous. *Proceedings of the National Academy of Sciences*, *112*, 7105–7106.

Warren, M. P., & Brooks-Gunn, J. (1989). Mood and behavior during adolescence: Evidence for hormonal factors. *Journal of Clinical Endocrinology and Metabolism*, *69*, 77–83.

Warrington, E. K., & McCarthy, R. (1983). Categories of knowledge: Further fractionations and an attempted integration. *Brain*, *110*, 1273–1296.

Warrington, E. K., & Shallice, T. (1979). Semantic access dyslexia. *Brain*, *102*, 43–63.

Wasser, S. K., & Barash, D. P. (1983). Reproductive suppression among female mammals: Implication for biomedicine and sexual selection theory. *Quarterly Review of Biology*, *58*, 523–538.

Waszak, P. M., Kasprzycka-Waszak, W., & Kubanek, A. (2018). The spread of medical fake news in social media – The pilot quantitative study. *Health Policy and Technology*, *7*, 115–118.

Watkins, C. E., Campbell, V. L., Neiberding, R., & Hallmark, R. (1995). Contemporary practice of psychological assessment by clinical psychologists. *Professional Psychology: Research and Practice*, *26*, 54–60.

Watkins, K. E., Vargha-Khadem, F., Ashburner, J., Passingham, R. E., Connelly, A., … Gadian, D. G. (2002). MRI analysis of an inherited speech and language disorder: Structural brain abnormalities. *Brain*, *125*, 465–478.

Watson, J. B. (1913). Psychology as the behaviorist views it. *Psychological Review*, *20*, 158–177.

Watson, J. B. (1930). *Behaviorism*. Chicago: University of Chicago Press.

Watson, J. B., & Rayner, R. R. (1920). Conditioned emotional reactions. *Journal of Experimental Psychology*, *3*, 1–14.

Watson, J. C., Gordon, L. B., Stermac, L., Kalogerakos, F., & Steckley, P. (2003). Comparing the effectiveness of process-experiential with cognitive-behavioral psychotherapy in the treatment of depression. *Journal of Consulting and Counseling Psychology*, *71*, 773–781.

Watson, M. W., & Getz, K. (1990). The relationship between Oedipal behaviors and children's family role concepts. *Merrill-Palmer Quarterly*, *36*, 487–505.

Watts, R. E. (2000). Adlerian counseling: A viable approach for contemporary practice. *TCA Journal*, *28*, 11–23.

Wayment, H. A., & Peplau, L. A. (1995). Social support and well-being among lesbian and heterosexual women: A structural modeling approach. *Personality and Social Psychology Bulletin*, *21*, 1189–1199.

Weaver, A. D., MacKeigan, K. L., & MacDonald, H. A. (2011). Experience and perceptions of young adults in friends with benefits relationships: A qualitative study. *The Canadian Journal of Human Sexuality*, *20*, 41–53.

Weaver, I. C., Cervoni, N., Champagne, F. A., D'Alessio, A. C., Sharma, S., Seckl, J. R., ... Meaney, M. J. (2004). Epigenetic programming by maternal behavior. *Nature Neuroscience*, *7*, 847–854.

Webb, C. A., Rosso, I. M., & Rauch, S. L. (2017). Internet-based cognitive behavioral therapy for depression. *Current Progress & Future Directions*, *25*, 114–122.

Webb, W. B., & Cartwright, R. D. (1978). Sleep and dreams. *Annual Review of Psychology*, *29*, 223–252.

Weber, B., Jermann, F., Gex-Fabry, M., Nallet, A., Bondolfi, G., & Aubry, J. M. (2010). Mindfulness-based cognitive therapy for bipolar disorder: A feasibility trial. *European Psychiatry*, *25*, 334–337.

Wechsler, D. (1939). *The measurement of adult intelligence*. Baltimore: Williams & Witkins.

Wechsler, D. (2009). *Wechsler Memory Scale–Fourth Edition*. San Antonio, TX: Pearson.

Weeks, D. L., & Anderson, L. P. (2000). The interaction of observational learning with overt practice: Effects on motor skill learning. *Acta*

Psychologica, *104*, 259–271.

Weinberg, A., Olvet, D. M., & Hajcak, G. (2010). Increased error-related brain activity in generalized anxiety disorder. *Biological Psychiatry*, *85*, 472–480.

Weinsier, R. L., Hunter, G. R., Desmond, R. A., Byrne, N. M., Zuckerman, P. A., & Darnell, B. (2002). Free-living activity expenditure in women successful and unsuccessful at maintaining a normal body weight. *American Journal of Clinical Nutrition*, *75*, 499–504.

Weisman, A. G., Lopez, S. R., Ventura, J., Nuechterlein, K. H., Goldstein, M. J., & Hwang, S. (2000). A comparison of psychiatric symptoms between Anglo-Americans and Mexican-Americans with schizophrenia. *Schizophrenia Bulletin*, *26*, 817–824.

Weiss, A. (2018). Personality traits: A view from the animal kingdom. *Journal of Personality*, *86*, 12–22.

Weiss, A., King, J. E., & Hopkins, W. D. (2007). A cross-setting study of chimpanzee (*Pan troglodytes*) personality structure and development: Zoological parks and Yerkes National Primate Research Center. *American Journal of Primatology*, *69*, 1264–1277.

Weiss, E., Kemmler, G., Deisenhammer, E., Fleischhacker, W., & Delazer, M. (2003). Sex differences in cognitive functions. *Personality and Individual Differences*, *35*, 863–875.

Weissman, M. M., Markowitz, J. C., Klerman, G. L. (2000). *Comprehensive guide to interpersonal psychotherapy*. New York: Basic Books.

Weisz, J. R., Weiss, B., Han, S. S., Granger, D. A., & Morton, T. (1995). Effects of psychotherapy with children and adolescents revisited: A meta-analysis of treatment outcome studies. *Psychological Bulletin*, *117*, 450–468.

Weitzer, R., & Tuch, S. A. (2004). Race and perceptions of police misconduct. *Social Problems*, *51*, 305–325.

Wells, B., & Corts, D. P. (2008). Attitudes towards fraternities and sororities: Evidence of implicit, ingroup favoritism. *College Student Journal*, *42*, 842–846.

Wenk, G. (2010). *Your brain on food: How chemicals control your thoughts and feelings*. Oxford, UK: Oxford University Press.

Wennberg, R. A., & Tator, C. H. (2003). National Hockey League reported concussions, 1986–1987 to 2001–2002. *Canadian Journal of Neurological Sciences*, *30*, 206–209.

Wennberg, R. A., & Tator, C. H. (2008). Concussion incidence and time lost from play in the NHL during the past ten years. *Canadian Journal of Neurological Sciences*, *35*, 647–651.

Werker, J. F. (2003). Baby steps to learning language. *Journal of Pediatrics (Supplement: Special Issue)*, *143*, S62–S69.

Werker, J. F., & Lalonde, C. E. (1988). Cross-language speech perception: Initial capabilities and developmental change. *Developmental Psychology*, *24*, 672–683.

Werker, J. F., & Tees, R. C. (1984). Phonemic and phonetic factors in adult cross-language speech perception. *Journal of the Acoustical Society of America*, *75*, 1866–1878.

Werker, J. F., Yeung, H. H., & Yoshida, K. A. (2012). How do infants become experts at native-speech perception? *Current Directions in Psychological Science*, *21*, 221–226.

Wernicke, C. (1874). *Der aphasische symptomencomplex*. Breslau, Germany: Kohn and Weigert.

West, E. A., & Carelli, R. M. (2016). Nucleus accumbens core and shell differentially encode reward-associated cues after reinforcer devaluation. *Journal of Neuroscience*, *36*, 1128–1139.

West, G. L., Konishi, K., Diarra, M., Benady-Chorney, J., Drisdelle, B. L., Dahmani, L., ... Bohbot, V. D. (2018). Impact of video games on plasticity of the hippocampus. *Molecular Psychiatry*, *23*, 1566–1574.

Westen, D. (1998). The scientific legacy of Sigmund Freud: Toward a psychodynamically informed psychological science. *Psychological Bulletin*, *124*, 333–371.

Westerwick, A., Johnson, B. K., & Knobloch-Westerwick, S. (2017). Confirmation biases in selective exposure to political online information: Source bias vs content bias. *Communication Monographs*, *84*, 343–364.

Wever, E. G., & Bray, C. W. (1930). The nature of acoustic response: The relation between sound frequency and frequency of impulses in the auditory nerve. *Journal of Experimental Psychology*, *13*, 3733–3787.

Wever, R. A., Polasek, J., & Wildgruber, C. M. (1983). Bright light affects human circadian rhythms. *European Journal of Physiology*, *396*, 85–87.

Whaley, A. L. (2018). Advances in stereotype threat research on African Americans: Continuing challenges to the validity of its role in the achievement gap. *Social Psychology of Education: An International Journal*, *21*, 111–137.

White, C., Brown, J., & Edwards, M. (2013). Altered visual perception in long-term ecstasy (MDMA) users. *Psychopharmacology*, *229*, 155–165.

Whiten, A. (2000). Primate culture and social learning. *Cognitive Science*, *24*, 477–508.

Whitson, J. A., & Galinsky, A. D. (2008). Lacking control increases illusory pattern perception. *Science*, *322*, 115–117.

Whorf, B. L. (1973). *Language, thought, and reality: Selected writings of Benjamin Whorf*. J. B. Carroll (Ed.). Oxford, UK: Technology Press of MIT.

Wiebe, S. A., Fang, H., Johnson, C., James, K. E., & Espy, K. A. (2014). Determining the impact of prenatal tobacco exposure on self-regulation at 6 months. *Developmental Psychology*, *50*, 1746–1756.

Wiens, S. (2005). Interoception in emotional experience. *Current Opinion in Neurology*, *18*, 442–447.

Wight, R. G., LeBlanc, A. J., & Badgett, M. V. L. (2013). Same-sex legal marriage and psychological well-being: Findings from the California Health Interview Survey. *American Journal of Public Health*, *103*, 339–346.

Wijdicks, E. F. (2006). Minimally conscious state vs. persistent vegetative state: The case of Terry (Wallis) vs. the case of Terri (Schiavo). *Mayo Clinic Proceedings*, *81*, 1155–1158.

Wijnen, V. J. M., van Boxtel, G. J. M., Eilander, H. J., & de Gelder, B. (2007). Mismatch negativity predicts recovery from the vegetative state. *Clinical Neurophysiology*, *118*, 597–605.

Williams, K. D., & Nida, S. A. (2011). Ostracism: Consequences and coping. *Current Directions in Psychological Science*, *20*, 71–75.

Williams, K. M., Nathanson, C., & Paulhus, D. L. (2010). Identifying and profiling scholastic cheaters: Their personality, cognitive ability, and motivation. *Journal of Experimental Psychology: Applied*, *16*, 293–307.

Williams, T. J., Schimel, J., Hayes, J., & Usta, M. (2014). Following and resisting body image ideals in advertising: The moderating role of extrinsic contingency focus. *Self and Identity*, *13*, 398–418.

Williamson, A. M., & Feyer, A. (2000). Moderate sleep deprivation produces impairments in cognitive and motor performance equivalent to legally prescribed levels of alcohol intoxication. *Occupational & Environmental Medicine*, *57*, 649–655.

Willingham, D. T. (2004). Reframing the mind: How Howard Gardner became a hero among educators simply by redefining talents as "intelligences." *Education Next*, *4*, 19–24.

Willis, J., & Todorov, A. (2006). First impressions: Making up your mind after a 100-ms exposure to a face. *Psychological Science*, *17*, 592–598.

Willner, P., Scheel-Krüger, J., & Belzung, C. (2013). The neurobiology of depression and antidepressant action. *Neuroscience and Biobehavioral Reviews*, *37*, 2331–2371.

Willner, P., Towell, A., Sampson, D., Sophokleous, S., & Muscat, R. (1987). Reduction of sucrose preference by chronic unpredictable mild stress, and its restoration by a tricyclic antidepressant. *Psychopharmacology*, *93*, 358–364.

Wilson, A. E., & Ross, M. (2003). The identity function of autobiographical memory: Time is on our side. *Memory*, *11*, 137–149.

Wilson, M. E., Fisher, J., Fischer, A., Lee, V., Harris, R. B., & Bartness, T. J. (2008). Quantifying food intake in socially housed monkeys: Social status effects on caloric consumption. *Physiology & Behavior*, 94, 586–594.

Wilson, P. M., Mack, D. E., & Grattan, K. P. (2008). Understanding motivation for exercise: A self-determination theory perspective. *Canadian Psychology*, *49*, 250–256.

Wimmer, F., Hoffmann, R. F., Bonato, R. A., & Moffitt, A. R. (1992). The effects of sleep deprivation on divergent thinking and attention processes. *Journal of Sleep Research*, *1*, 223–230.

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constrained function of wrong beliefs in young children's understanding of deceptions. *Cognition*, *13*, 103–128.

Wineburg, S., McGrew, S., Breakstone, J., & Ortega, T. (2016). Evaluating information: The cornerstone of civic online reasoning. Stanford Digital Repository. Available at http://purl.stanford.edu/fv751yt5934

Winkielman, P., Schwarz, N., & Nowak, A. (2002). Affect and processing dynamics: Perceptual fluency enhances evaluations. In S. C. Moore

(Ed.), *Emotional cognition: From brain to behaviour* (pp. 111–135). Amsterdam, Netherlands: John Benjamins Publishing Company.

Winkler, I., Haden, G., Lading, O., Sziller, I., & Honing, H. (2008). Newborn infants detect the beat in music. *Proceedings of the National Academy of Science the United States of America*, *106*, 2468–2471.

Winter, B., Breitenstein, C., Mooren, F. C., Voelker, K., Fobker, M., Lechtermann, A., et al. (2007). High impact running improves learning. *Neurobiology of Learning and Memory*, *87*, 597–609.

Winterer, G. (2010). Why do patients with schizophrenia smoke? *Current Opinion in Psychiatry*, *23*, 112–119.

Witelson, S. F., Beresh, H., & Kigar, D. L. (2006). Intelligence and brain size in 100 postmortem brains: Sex, lateralization and age factors. *Brain: A Journal of Neurology*, *129*, 386–398.

Witelson, S. F., Kigar, D. L., & Harvey, T. (1999). The exceptional brain of Albert Einstein. *The Lancet*, *353*, 2149–2153.

Wixted, J. T., Mickes, L., & Fisher, R. P. (2018). Rethinking the reliability of eyewitness testimony. *Perspectives on Psychological Science*, *13*, 324–335.

Wobber, V., Hare, B., Maboto, J., Lipson, S., Wrangham, R., & Ellison, P. T. (2010). Differential changes in steroid hormones before

competition in bonobos and chimpanzees. *Proceedings of the National Academy of Sciences USA*, *107*, 12457–12462.

Wojtowicz, J.M. (2012). Adult neurogenesis. From circuits to models. *Behavioural Brain Research*, *227*, 490–496.

Wolf, W., Levordashka, A., Ruff, J. R., Kraaijeveld, S., Lueckmann, J.-M., & Williams, K. D. (2015). Ostracism online: A social media ostracism paradigm. *Behavior Research Methods*, *47*, 361–373.

Wolpe, J. (1990). *The practice of behavior therapy*. Elmsford, NY: Pergamon Press.

Wong, C. K., & Read, J. D. (2011). Positive and negative effects of physical context reinstatement on eyewitness recall and identification. *Applied Cognitive Psychology*, *25*, 2–11.

Wong, M. M., Robertson, G. C., & Dyson, R. B. (2015). Prospective relationship between poor sleep and substance-related problems in a sample of adolescents. *Alcohol: Clinical and Experimental Research*, *39*, 355–362.

Woo, J. S. T., Brotto, L. A., & Gorcalka, B. (2010). Sex guilt and culture-linked barriers to testicular examinations. *International Journal of Sexual Health*, *22*, 144–154.

Woo, J. S. T., Brotto, L. A., & Gorzalka, B. (2012). The relationship between sex guilt and sexual desire in a community sample of

Chinese and Euro-Canadian women. *Journal of Sex Research*, *49*, 290–298.

Wood, D., Harms, P., & Vazire, S. (2010). Perceiver effects as projective tests: What your perceptions of others say about you. *Journal of Personality and Social Psychology*, *99*, 174–190.

Woodberry, K. A., Giuliano, A. J., & Seidman, L. J. (2008). Premorbid IQ in schizophrenia. *American Journal of Psychiatry*, *165*, 579–587.

Woodward, N. D., Zald, D. H., Ding, Z., Riccardi, P., Ansari, M. S., ... Kessler, R.M. (2009). Cerebral morphology and dopamine D2/D3 receptor distribution in humans: A combined [18F]fallypride and voxel-based morphometry study. *NeuroImage*, *46*, 31–38.

Woodworth, R. S. (1929). *Psychology: A study of mental life* (2nd ed.). [Online]. Retrieved from www.gutenberg.org/files/31382/31382-h/31382-h.htm

Woody, E. Z., & Bowers, K. (1994). A frontal assault on dissociated control. In S. J. Lynn & J. W. Rhue (Eds.), *Dissociation: Clinical and theoretical perspectives* (pp. 52–79). New York: Guilford Press.

Woody, E. Z., & Farvolden, P. (1998). Dissociation in hypnosis and frontal executive function. *American Journal of Clinical Hypnosis*, *40*, 206–216.

Wright, D. (1997). Getting out of the asylum: Understanding the confinement of the insane in the nineteenth century. *Social History of Medicine*, *10*, 137–155.

Wright, I. C., Rabe-Hesketh, S., Woodruff, P. W., David, A. S., Murray, R. M., & Bullmore, E. T. (2000). Meta-analysis of regional brain volumes in schizophrenia. *American Journal of Psychiatry*, *157*, 16–25.

Wright, J. C., Huston, A. C., Scantlin, R., & Kotler, J. (2001). The Early Window Project: "Sesame Street" prepares children for school. In S. M. Fisch & R. T. Truglio (Eds.), *"G" is for "growing": Thirty years of research on children and* Sesame Street (pp. 97–114). Mahwah, NJ: Lawrence Erlbaum.

Wright, S. C., Aron, A., McLaughlin-Volpe, T., & Ropp, S. A. (1997). The extended contact effect: Knowledge of cross-group friendships and prejudice. *Journal of Personality and Social Psychology*, *73*, 73–90.

Wyer, Jr., R. S., & Collins, J. E. (1992). A theory of humor elicitation. *Psychological Review*, *99*, 663–688.

Yamagata, S., Suzuki, A., Ando, J., Ono, Y., Kijima, N., ... Jang, K. L. (2006). Is the genetic structure of human personality universal? A cross-cultural twin study from North America, Europe, and Asia. *Journal of Personality and Social Psychology*, *90*, 987–998.

Yamazaki, T., & Tanaka, S. (2009). Computational models of timing mechanisms in the cerebellar granular layer. *Cerebellum*, *8*, 423–

432.

Yang, L. J., & Schnaar, R. L. (2008). Axon regeneration inhibitors. *Neurological Research*, *30*, 1047–1052.

Yang, Y., Raine, A., Colletti, P., Toga, A., & Narr, K. (2010). Morphological alterations in the prefrontal cortex and the amygdala in unsuccessful psychopaths. *Journal of Abnormal Psychology*, *119*, 546–554.

Yarrow, K., Brown, P., & Krakauer, J. W. (2009). Inside the brain of an elite athlete: The neural processes that support high achievement in sports. *Nature Reviews Neuroscience*, *10*, 585–596.

Ybarra, O., Burnstein, E., Winkielman, P., Keller, M., Manis, M., Chan, E., & Rodriguez, J. (2008). Mental exercising through simple socializing: Social interaction promotes general cognitive functioning. *Personality and Social Psychology Bulletin*, *34*, 248–259.

Yerkes, R. M., & Dodson, J. D. (1908). The relation of strength of stimulus to rapidity of habit formation. *Journal of Comparative Neurology and Psychology*, *18*, 459–482.

Yoo, S. K., & Skovholt, T. M. (2001). Cross-cultural examination of depression expression and help-seeking behavior: A comparative study of American and Korean college students. *Journal of College Counseling*, *4*, 10–19.

Yoon, S., Kleinman, M., Mertz, J., & Brannick, M. (2019). Is social network site usage related to depression? A meta-analysis of Facebook–depression relations. *Journal of Affective Disorders*, *248*, 65–72.

Young, M. B., Andero, R., Ressler, K. J., & Howell, L. L. (2015). 3,4-methylenedioxymethamphetamine facilitates fear extinction learning. *Translational Psychiatry*, *5*, e634.

Young, S. N., & Leyton, M. (2002). The role of serotonin in human mood and social interaction: Insight from altered tryptophan levels. *Pharmacology Biochemistry and Behavior*, *71*, 857–865.

Yuile, A., & McVey, G. L. (2009). The role of social influence in the prevention of disordered eating among young adolescent females. *Journal of School Mental Health*, *2*, 47–60.

Zadra, A., & Donderi, D. C. (2000). Nightmares and bad dreams: Their prevalence and relationship to well-being. *Journal of Abnormal Psychology*, *109*, 273–281.

Zahn-Waxler, C., Radke-Yarrow, M., Wagner, E., & Chapman, M. (1992). Development of concern for others. *Developmental Psychology*, *28*, 126–136.

Zajonc, R. B. (1976). Family configuration and intelligence. *Science*, *192*, 227–236.

Zajonc, R. B., Heingartner, A., & Herman, E. M. (1969). Social enhancement and impairment of performance in the cockroach. *Journal of Personality and Social Psychology*, *13*, 83–92.

Zak, P. J. (2008). The neurobiology of trust. *Scientific American*, *298*, 88–92.

Zaki, J., Wager, T.D., Singer, T., Keysers, C., & Gazzola, V. (2016). The anatomy of suffering: Understanding the relationship between nociceptive and empathic pain. *Trends in Cognitive Sciences*, *20*, 249–259.

Zalesky, A., Solwij, N., Yücel, M., Lubman, D. I., Takagi, M., ... Seal, M. (2012). Effect of long-term cannabis use on axonal fibre connectivity. *Brain*, *135*, 2245–2255.

Zaman, R., Thind, D., & Kocmur, M. (2008). Transcranial magnetic stimulation in schizophrenia. *Neuroendocrinological Letters*, *1*, 147–160.

Zanna, M. P., Kiesler, C. A., & Pikonis, P. A. (1970). Positive and negative attitudinal affect established by classical conditioning. *Journal of Personality and Social Psychology*, *14*, 321–328.

Zatorre, R. J., & Zarate, J. M. (2010). Cortical processing of music. In D. Poeppel, T. Overath, A. N. Popper, and R. R. Fay (Eds.), *The human auditory cortex*. New York: Springer.

Zelazo, N. A., Zelazo, P. R., Cohen, K. M., & Zelazo, P. D. (1993). Specificity of practice effects on elementary neuromotor patterns. *Developmental Psychology*, *29*, 686–691.

Zentall, T. R. (2012). Perspectives on observational learning in animals. *Journal of Comparative Psychology*, *126*, 114–128.

Zhang, J., Zhu, Y., Zhan, G., Fenik, P., Panossian, L., Wang, M. M., … Veasey, S. (2014). Extended wakefulness: Compromised metabolics in and degeneration of locus ceruleus neurons. *Journal of Neuroscience*, *34*, 4418–4431.

Zhu, J., Yung, W., Chow, B. K., Chan, Y., & Wang, J. (2006). The cerebellar-hypothalamic circuits: Potential pathways underlying cerebellar involvement in somatic-visceral integration. *Brain Research Reviews*, *52*, 93–106.

Zhu, X. S., Dalal, D. K., & Hwang, T. (2017). Is maximizing a bad thing? Linking maximizing tendency to positive outcomes through future-oriented thinking. *Journal of Individual Differences*, *38*, 94–101.

Zimbardo, P., & Duncan, N. (2012). *The demise of guys: Why boys are struggling and what we can do about it*. TED eBook series.

Zimbardo, P. G. (2004). *A situationist perspective on the psychology of evil: Understanding how good people are transformed into perpetrators*. New York: Guilford Press.

Zimbardo, P. G. (2007). *The Lucifer effect: Understanding how good people turn evil*. New York: Random House.

Zimmerman, F. J., & Christakis, D. A. (2005). Children's television viewing and cognitive outcomes: A longitudinal analysis of national data. *Archives of Pediatric and Adolescent Medicine*, *159*, 619–625.

Zimmerman, F. J., Christakis, D. A., & Meltzoff, A. N. (2007). Association between media viewing and language development in children under 2 years. *Journal of Pediatrics*, *151*, 354–368.

Zucker, R. A., Donovan, J. E., Masten, A. S., Mattson, M. E., & Moss, H. B. (2008). Early developmental processes and the continuity of risk for underage drinking and problem drinking. *Pediatrics*, *121*, 5252–5272.

Zunszain, P. A., Anacker, C., Cattaneo, A., Carvalho, L. A., & Pariante, C. M. (2011). Glucocorticoids, cytokines and brain abnormalities in depression. *Progress in Neuropsychopharmacology & Biological Psychiatry*, *35*, 722–729.

Zuroff, D. C., Fournier, M. A., Patall, E. A., & Leybman, M. J. (2010). Steps toward an evolutionary personality psychology: Individual differences in the social rank domain. *Canadian Psychology*, *51*, 58–66.

Glossary

abnormal psychology

the study of mental illness

absolute threshold

the minimum amount of energy or quantity of a stimulus required for it to be reliably detected at least 50% of the time it is presented

accommodation

a creative process whereby people modify their belief structures based on experience

acetylcholine

one of the most widespread neurotransmitters within the body, found at the junctions between nerve cells and skeletal muscles; it is very important for voluntary movement

achievement motivation

the drive to perform at high levels and to accomplish significant goals

acquisition

the initial phase of learning in which a response is established

acronyms

pronounceable words whose letters represent the initials of an important phrase or set of items

action potential

a wave of electrical activity that originates at the beginning of the axon near the cell body and rapidly travels down its length

activation–synthesis hypothesis
suggests that dreams arise from brain activity originating from bursts of excitatory messages from the pons, a part of the brainstem

active phase
phase of schizophrenia during which people typically experience delusional thoughts, hallucinations, or disorganized patterns of thoughts, emotions, and behaviour

adrenal glands
a pair of endocrine glands located adjacent to the kidneys that release stress hormones, such as cortisol and epinephrine

affiliation motivation
see need to belong

agonists
drugs that enhance or mimic the effects of a neurotransmitter's action

agoraphobia
often associated with panic disorder, agoraphobia results from an intense fear of having a panic attack in public; as a result of this fear, the individual may begin to avoid public settings and increasingly isolate him- or herself

algorithms
problem-solving strategies based on a series of rules

all-or-none principle

individual nerve cells fire at the same strength every time an action potential occurs

allostasis
motivation is not only influenced by current needs, but also by the anticipation of future needs

altruism
helping others in need without receiving or expecting reward for doing so

Alzheimer's disease
a degenerative and terminal condition resulting in severe damage of the entire brain

amnesia
a profound loss of at least one form of memory

amotivational
a feeling of having little or no motivation to perform a behaviour

amygdala
a group of nuclei in the medial portion (near the middle) of the temporal lobes in each hemisphere of the brain that facilitates memory formation for emotional events, mediates fear responses, and appears to play a role in recognizing and interpreting emotional stimuli, including facial expressions

analytic system
operates at the explicit level of consciousness, is slower and methodical, and uses logic and discursive thinking (i.e., reasoning using language)

analytical psychology

focuses on the role of unconscious archetypes in personality development

anchoring effect
occurs when an individual attempts to solve a problem involving numbers and uses previous knowledge to keep (i.e., anchor) the response within a limited range

anecdotal evidence
an individual's story or testimony about an observation or event that is used to make a claim as evidence

anorexia nervosa
an eating disorder that involves (1) self-starvation, (2) intense fear of weight gain and dissatisfaction with one's body, and (3) denial of the serious consequences of severely low weight

antagonists
inhibit neurotransmitter activity by blocking receptors or preventing synthesis of a neurotransmitter

anterograde amnesia
the inability to form new memories for events occurring after a brain injury

anthropometrics
(literally, "the measurement of people") methods of measuring physical and mental variation in humans

antianxiety drugs
affect the activity of gamma-aminobutyric acid (GABA), an inhibitory neurotransmitter that reduces neural activity

antidepressant drugs

medications designed to reduce symptoms of depression

antipsychotic drugs

generally used to treat symptoms of psychosis, including delusions, hallucinations, and severely disturbed or disorganized thought

antisocial personality disorder (APD)

a profound lack of empathy or emotional connection with others, a disregard for others' rights or preferences, and a tendency toward imposing one's own desires, often violently, onto others regardless of the consequences for other people or, often when younger, other animals

anxiety disorders

a category of disorders involving fear or nervousness that is excessive, irrational, and maladaptive

APD

see antisocial personality disorder

aphasia

a language disorder caused by damage to the brain structures that support using and understanding language

appeal to authority

the belief in an "expert's" claim even when no supporting data or scientific evidence is present

appeal to common sense

a claim that appears to be sound, but lacks supporting scientific evidence

applied behaviour analysis

involves using close observation, prompting, and reinforcement to teach behaviours, often to people who experience difficulties and challenges owing to a developmental condition such as autism

appraisal
the cognitive act of assessing and evaluating the potential threat and demands of an event

approach goal
an enjoyable and pleasant incentive that a person is drawn toward, such as praise, financial reward, or a feeling of satisfaction

ARAS
see ascending reticular activating system

archetypes
images and symbols that reflect common "truths" held across cultures, such as universal life experiences or types of people

arousal theory of extraversion
extraversion is determined by people's threshold for arousal

ascending reticular activating system (ARAS)
plays a central role in controlling the arousal response

assimilation
a conservative process, whereby people fit new information into the belief systems they already possess

asylums
residential facilities for the mentally ill

attachment

the enduring emotional bond formed between individuals

attachment behavioural system

focused on meeting our own needs for security

attention

selects which information will be passed on to STM

attention-deficit hyperactivity disorder (ADHD)

a developmental disorder in which children show inappropriate levels of hyperactivity and impulsivity while also having problems maintaining their attention to people or activities

attitude inoculation

a strategy for strengthening attitudes and making them more resistant to change by first exposing people to a weak counter-argument and then refuting that argument

atypical antipsychotics

drugs that are less likely to produce side effects including movement disorders (like tardive dyskinesia) that commonly occur with first-generation antipsychotics

autonomic nervous system

the portion of the peripheral nervous system responsible for regulating the activity of organs and glands

autonomous sensory meridian response (ASMR)

a condition in which specific auditory or visual stimuli trigger tingling sensations in the scalp and neck, sometimes extending across the back and shoulders

availability heuristic
entails estimating the frequency of an event based on how easily examples of it come to mind

aversive conditioning
a behavioural technique that involves replacing a positive response to a stimulus with a negative response, typically by using punishment

avoidance goal
an attempt to avoid an unpleasant outcome such as shame, embarrassment, losing money, or feeling emotional pain

avoidance learning
a specific type of negative reinforcement that removes the possibility that a stimulus will occur

avoidant personality disorder (AvPD)
individuals avoid social interactions, including those at school or work, because they feel inadequante and are deeply afraid of being rejected

axon
transports information in the form of electrochemical reactions from the cell body to the end of the neuron

axon terminals
bulb-like extensions filled with vesicles (little bags of molecules)

BAS
see behavioural activation system/em>

basal ganglia

a group of three structures that are involved in facilitating planned movements, skill learning, and integrating sensory and movement information with the brain's reward system

BDNF

see brain-derived neurotrophic factor

behavioural activation system (BAS)

a "GO" system, arousing the person to action in the pursuit of desired goals

behavioural genetics

the study of how genes and the environment influence behaviour

behavioural genomics

the study of how specific genes, in their interactions with the environment, influence behaviour

behavioural inhibition system (BIS)

a "danger" system, motivating the person to action in order to avoid punishments or other negative outcomes

behavioural therapies

therapies that attempt to directly address problem behaviours and the environmental factors that trigger them

behaviourism

an approach that dominated the first half of the 20th century of North American psychology and had a singular focus on studying only observable behaviour, with little to no reference to mental events or instincts as possible influences on behaviour

belief perseverance
when an individual remains committed to their decision or belief even in the face of evidence against it

between-subjects design
an experimental design in which we compare the performance of participants who are in different groups

bibliotherapy
the use of self-help books and other reading materials as a form of therapy

binocular depth cues
distance cues that are based on the differing perspectives of both eyes

biopsychosocial model
a means of explaining behaviour as a product of biological, psychological, and sociocultural factors

bipolar disorder
characterized by extreme highs and lows in mood, motivation, and energy

BIS
see behavioural inhibition system

blood–brain barrier
a network of tightly packed cells that only allow specific types of substances to move from the bloodstream to the brain in order to protect delicate brain cells against harmful infections and other substances

BMI

see body mass index

body mass index (BMI)
a statistic commonly used for estimating a healthy body weight given an individual’s height

borderline personality disorder (BPD)
a disorder characterized by intense extremes between positive and negative emotions, an unstable sense of self, impulsivity, and difficult social relationships

bottom-up processing
occurs when we perceive individual bits of sensory information (e.g., sounds) and use them to construct a more complex perception (e.g., a message)

BPD
see borderline personality disorder

brain death
a condition in which the brain, specifically including the brainstem, no longer functions

brainstem
the “stem” or bottom of the brain and consists of two structures: the medulla and the pons

brain-derived neurotrophic factor (BDNF)
a protein in the nervous system that promotes survival, growth, and formation of new synapses

Broca’s area

a region of the left frontal lobe that controls our ability to articulate speech sounds that compose words

bulimia nervosa
an eating disorder that is characterized by periods of food deprivation, binge-eating, and purging

bystander effect
the observation that an individual is less likely to help when they perceive that others are not helping

Cannon-Bard theory of emotion
the brain interprets a situation and generates subjective emotional feelings, and these representations in the brain trigger responses in the body

caregiving behavioural system
focused on meeting the needs of others

case study
an in-depth report about the details of a specific case

catatonic schizophrenia
symptoms include episodes in which a person remains mute and immobile—sometimes in bizarre positions—for extended periods. Individuals may also exhibit repetitive, purposeless movements

categories
clusters of interrelated concepts

CBT

see cognitive–behavioural therapy

cell body
the part of a neuron that contains the nucleus that houses the cell’s genetic material

central executive
the control centre of working memory; it coordinates attention and the exchange of information among the three storage components

central nervous system (CNS)
consists of the brain and the spinal cord

central route to persuasion
occurs when people pay close attention to the content of a message, evaluate the evidence presented, and examine the logic of the arguments

central tendency
a measure of the central point of a distribution

cerebellum
(Latin for “little brain”) the lobe-like structure at the base of the brain that is involved in the monitoring of movement, maintaining balance, attention, and emotional responses

cerebral cortex
the convoluted, wrinkled outer layer of the brain that is involved in multiple higher functions, such as thought, language, and personality

cerebral hemispheres
nearly symmetrical halves of the brain that contain the same structures

chaining

involves linking together two or more shaped behaviours into a more complex action or sequence of actions

chronotype

the tendency to prefer sleeping earlier or later in a given 24-hour period

chromosomes

structures in the cellular nucleus that are lined with all of the genes an individual inherits

chunking

organizing smaller units of information into larger, more meaningful units

circadian rhythms

internally driven daily cycles of approximately 24 hours affecting physiological and behavioural processes

classical conditioning

a form of associative learning in which an organism learns to associate a neutral stimulus (e.g., a sound) with a biologically relevant stimulus (e.g., food), which results in a change in the response to the previously neutral stimulus (e.g., salivation)

client-centred therapy

focuses on individuals' abilities to solve their own problems and reach their full potential with the encouragement of the therapist

clinical psychologists

have obtained PhDs and are able to formally diagnose and treat mental health issues ranging from the everyday and mild to the chronic and severe

clinical psychology

the field of psychology that concentrates on the diagnosis and treatment of psychological disorders

cochlea

a fluid-filled membrane that is coiled in a snail-like shape and contains the structures that convert sound into neural impulses

cognitive–behavioural therapy (CBT)

a form of therapy that consists of procedures such as cognitive restructuring, stress inoculation training, and exposing people to experiences they may have a tendency to avoid

cognitive development

the study of changes in memory, thought, and reasoning processes that occur throughout the lifespan

cognitive dissonance theory

when we hold inconsistent beliefs, it creates a kind of aversive inner tension, or "dissonance"; we are then motivated to reduce this tension in whatever way we can

cognitive psychology

a modern psychological perspective that focuses on processes such as memory, thinking, and language

cohort effect

differences between people that result from being born in different time periods

collective unconscious

a separate, non-personal realm of the unconscious that holds the collective memories and mythologies of humankind, stretching deep into our ancestral past

coma
a state marked by a complete loss of consciousness

community psychology
an area of psychology that focuses on identifying how individuals' mental health is influenced by the community in which they live, and emphasizes community-level variables such as social programs, support networks, and community resource centres to help those with mental illness adjust to the challenges of everyday life

companionate love
related to tenderness, and to the affection we feel when our lives are intertwined with another person

compensatory control
psychological strategies people use to preserve a sense of nonrandom order when personal control is compromised

computerized tomography (or CT scans)
a structural neuroimaging technique in which X-rays are sent through the brain by a tube that rotates around the head

concept
the mental representation of an object, event, or idea

concrete operational stage
(ages seven to 11 years) developmental stage at which children develop skills in logical thinking and manipulating numbers

conditioned emotional responses

consist of emotional and physiological responses that develop to a specific object or situation

conditioned response (CR)

the learned response that occurs to the conditioned stimulus

conditioned stimulus (CS)

a once-neutral stimulus that later elicits a conditioned response because it has a history of being paired with an unconditioned stimulus

conditioned taste aversion

acquired dislike or disgust for a food or drink because it was paired with illness

cones

photoreceptors that are sensitive to the different wavelengths of light that we perceive as colour

confirmation bias

occurs when an individual searches for only evidence that will confirm his or her beliefs instead of evidence that might disconfirm them

confounding variable

a variable outside of the researcher's control that might affect or provide an alternative explanation for the results

conjunction fallacy

reflects the mistaken belief that finding a specific member in two overlapping categories (i.e., a member of the conjunction of two categories) is more likely than finding any member of one of the larger, general categories

conscious mind

your current awareness, containing everything you are aware of right now

consciousness

a person’s subjective awareness, including thoughts, perceptions, experiences of the world, and self-awareness

conservation

the knowledge that the quantity or amount of an object is not the same as the physical arrangement and appearance of that object

consolidation

the process of converting short-term memories into long-term memories in the brain

construal-level theory

describes how information affects us differently depending on our psychological distance from the information

constructive memory

a process by which we first recall a generalized schema and then add in specific details

contact hypothesis

social contact between members of different groups is extremely important to overcoming prejudice

context-dependent memory

the idea that retrieval is more effective when it takes place in the same physical setting (context) as encoding

continuous reinforcement

every response made results in reinforcement

control group

the group that does not receive the treatment or stimuli targeting a specific behaviour; this group therefore serves as a baseline to which the experimental group is compared

control processes

shift information from one memory store to another

convenience samples

samples of individuals who are the most readily available

conventional morality

regards social conventions and rules as guides for appropriate moral behaviour

convergence

occurs when the eye muscles contract so that both eyes focus on a single object

Coolidge effect

the tendency for males to show renewed sexual interest when a new female becomes available

coping

the processes used to manage demands, stress, and conflict

core knowledge hypothesis

the theory that infants have inborn abilities for understanding some key aspects of their environment

cornea
the clear layer that covers the front portion of the eye and also contributes to the eye's ability to focus

coronary heart disease
a condition in which plaques form in the blood vessels that supply the heart with blood and oxygen, resulting in restricted blood flow

corpus callosum
a collection of neural fibres connecting the two brain hemispheres

correlational research
involves measuring the degree of association between two or more variables

cortical deafness
problems with hearing despite the fact that the patient's ears work perfectly

cortisol
a hormone secreted by the adrenal cortex (the outer part of the adrenal gland) that prepares the body to respond to stressful circumstances

counselling psychologists
mental health professionals who typically work with people who need help with more common problems such as stress and coping; issues concerning identity, sexuality, and relationships; anxiety and depression; and developmental issues such as childhood trauma

CR
see conditioned response

CRISPR

a technique that allows genetic material to be removed, added, or altered in specific locations of the genome

critical thinking

involves exercising curiosity and skepticism when evaluating the claims of others, and with our own assumptions and beliefs

cross-cortical storage

a phenomenon in which long-term declarative memories are distributed throughout the cortex of the brain, rather than being localized in one region

cross-fostered

being raised as a member of a family that was not of the same species

cross-sectional design

used to measure and compare samples of people at different ages at a given point in time

crystallized intelligence (Gc)

a type of intelligence that draws upon past learning and experience

CS

see conditioned stimulus

CT scan

see computerized tomography

culture-bound syndromes

expressions of distress that are recognized across a given culture but that tend not to appear outside of that culture

dark adaptation

the process by which the rods and cones become increasingly sensitive to light under low levels of illumination

Dark Triad

three traits—Machiavellianism, Psychopathy, and Narcissism—that describe a person who is socially destructive, aggressive, dishonest, and likely to commit harm in general

DBS

see deep brain stimulation

debriefing

when researchers explain the true nature of the study, and especially the nature of and reason for any deception

decentring

occurs when a person is able to "step back" from their normal consciousness and examine themselves more objectively, as an observer

deception

misleading or only partially informing participants of the true topic or hypothesis under investigation

declarative (explicit) memories

memories that we are consciously aware of and that can be verbalized, including facts about the world and one's own personal experiences

deep brain stimulation (DBS)

a technique that involves electrically stimulating specific regions of the brain

deep processing

encoding information about an item's meaning or its function

default mode network

a network of brain regions including the medial prefrontal cortex, posterior cingulate gyrus, and medial and lateral regions of the parietal lobe that is most active when an individual is awake but not responding to external stimuli

defence mechanisms

unconscious strategies the ego uses to reduce or avoid anxiety

deinstitutionalization

the movement of large numbers of psychiatric in-patients from their care facilities back into regular society

delaying gratification

putting off immediate temptations in order to focus on longer-term goals

delusions

beliefs that are not based on reality (at least from the perspective of the person's general culture)

demand characteristics

inadvertent cues given off by the experimenter or the experimental context that provide information about how participants are expected to behave

dementia

mild to severe disruption of mental functioning, memory loss, disorientation, poor judgment, and decision making

dendrites

small branches radiating from the cell body that receive messages from other cells and transmit those messages toward the rest of the cell

dependent personality disorder (DPD)

an excessive need to be taken care of, often requiring frequent assurance from others and help with everyday decision making

dependent variable

the observation or measurement that is recorded during the experiment and subsequently compared across all groups

descriptive statistics

a set of techniques used to organize, summarize, and interpret data

desirable difficulties

techniques that make studying slower and more effortful, but result in better overall remembering

determinism

the belief that all events are governed by lawful, cause-and-effect relationships

developmental psychology

the study of human physical, cognitive, social, and behavioural characteristics across the lifespan

deviation IQ

calculated by comparing a person's test score with the average score for people of the same age

Diagnostic and Statistical Manual of Mental Disorders (DSM)

a standardized manual to aid in the diagnosis of disorders

diasthesis–stress model
the interaction between a genetic predisposition for a disorder and life stress

DID
see dissociative identity disorder

difference threshold
the smallest difference between stimuli that can be reliably detected at least 50% of the time

diffusion of responsibility
the reduced personal responsibility that a person feels when more people are present in a situation

diffusion tensor imaging (or DTI)
a form of structural neuroimaging allowing researchers or medical personnel to measure white-matter pathways in the brain

discrimination
(1) Pavlovian-occurs when an organism learns to respond to one original conditioned stimulus but not to new stimuli that may be similar to the original stimulus; (2) Operant-occurs when an organism learns to respond to one original discriminative stimulus but not to new stimuli that may be similar to the original stimulus; (3) behaviour that disfavours or disadvantages members of a certain social group in some way.

discriminative stimulus
a cue or event that indicates that a response, if made, will be reinforced

dishabituation

the recovery of responsiveness to a habituated stimulus as the result of the presentation of a new stimulus

disorganized behaviour

the considerable difficulty people with schizophrenia may have completing the tasks of everyday life

disorganized schizophrenia

symptoms include thoughts, speech, behaviour, and emotions that are poorly integrated and incoherent; people with disorganized schizophrenia may also show inappropriate, unpredictable mannerisms

display rules

the unwritten expectations we have regarding when it is appropriate to show a certain emotion

dispositional attribution

see internal attribution

dissociation theory

explains hypnosis as a unique state in which consciousness is divided into two parts: a lower-level system involved with perception and movement and an "executive" system that evaluates and monitors these behaviours

dissociative disorder

a category of mental disorders characterized by a split between conscious awareness from feeling, cognition, memory, and identity

dissociative identity disorder (DID)

a person experiences a split in identity such that they feel different aspects of themselves as though they were separated from each other;

this can be severe enough that the person constructs entirely separate personalities, only one of which will generally be in control at a time

divided attention
paying attention to more than one stimulus or task at the same time

dizygotic twins
fraternal twins who come from two separate eggs fertilized by two different sperm cells that share the same womb; these twins have approximately 50% of their genetics in common

DNA (deoxyribonucleic acid)
a molecule formed in a double-helix shape that contains four amino acids: adenine, cytosine, guanine, and thymine

doctrine of specific nerve energies
first proposed in 1826 by the German physiologist Johannes Muller, the doctrine states that the different senses are separated in the brain

door-in-the-face technique
involves asking for something relatively big, then following with a request for something relatively small

dopamine
a monoamine neurotransmitter involved in such varied functions as mood, control of voluntary movement, and processing of rewarding experiences

dorsal stream
a neural circuit for vision that extends from the visual cortex to the parietal lobe

double-blind study

a study in which neither the participant nor the experimenter knows the exact treatment for any individual

dream analysis

a method of examining the details of a dream (the manifest content), in order to gain insight into the true meaning of the dream, the emotional, unconscious material that is being communicated symbolically (the latent content)

drive

a biological trigger that tells us we may be deprived of something and causes us to seek out what is needed, such as food or water

DRM procedure

participants study a list of highly related words called semantic associates

DSM

see Diagnostic and Statistical Manual of Mental Disorders

DTI

see diffusion tensor imaging

dual coding

occurs when information is stored in more than one form

dual-process models

models of behaviour that account for both implicit and explicit processes

dualism

the belief that there are properties of humans that are not material (a mind or soul separate from the body)

echoic memory

the auditory form of sensory memory

ecological validity

the results of a laboratory study can be applied to or repeated in the natural environment

ecstasy (MDMA)

a drug that is typically classified as a stimulant, but also has hallucinogenic effects

ECT

see electroconvulsive therapy

EEG

see electroencephalogram

ego

the decision maker, frequently under tension, trying to reconcile the opposing urges of the id and superego

egocentric

seeing the world only from one’s own perspective

elaboration likelihood model (ELM)

a dual-process model of persuasion that predicts whether factual information or other types of information will be most influential

elaborative rehearsal

prolonging exposure to information by thinking about its meaning

electroconvulsive therapy (ECT)
involves passing an electrical current through the brain in order to induce a temporary seizure

electroencephalogram (or EEG)
measures patterns of brain activity with the use of multiple electrodes attached to the scalp

embryonic stage
spans weeks two through eight of the gestational period, during which time the embryo begins developing major physical structures such as the heart and nervous system, as well as the beginnings of arms, legs, hands, and feet

emotion
a behaviour with the following three components: (a) a subjective thought and/or experience with (b) accompanying patterns of neural activity and physical arousal and (c) an observable behavioural expression (e.g., an emotional facial expression or changes in muscle tension)

emotional dialects
variations across cultures in how common emotions are expressed

empirically supported treatments
treatments that have been tested and evaluated using scientific methods

empiricism
a philosophical tenet that knowledge comes through experience

encoding specificity principle

retrieval is most effective when the conditions at the time of encoding and retrieval are the same

encoding

the process of storing information in the LTM system

endogenous rhythms

biological rhythms that are generated by our body independent of external cues such as light

endorphin

a hormone produced by the pituitary gland and the hypothalamus that functions to reduce pain and induce feelings of pleasure

entity theory

the belief that intelligence is a fixed characteristic and relatively difficult (or impossible) to change

entrainment

when biological rhythms become synchronized to external cues such as light, temperature, or even a clock

epigenetics

changes in gene expression that occur as a result of experience and that do not alter the genetic code

epinephrine

a hormone and neurotransmitter created in the adrenal gland on the kidneys

episodic buffer

a storage component of working memory that combines the images and sounds from the other two components into coherent, story-like episodes

episodic memories

declarative memories for personal experiences that seem to be organized around "episodes" and are recalled from a first-person ("I" or "my") perspective

escape learning

occurs if a response removes a stimulus that is already present

evidence-based therapies

see empirically supported treatments

evolution

the change in the frequency of genes occurring in an interbreeding population over generations

evolutionary psychology

attempts to explain human behaviours based on the beneficial function(s) they may have served in our species' development

exemplar

a specific example that best represents a category

experiential system

operates implicitly, quickly, and intuitively and is predominantly emotional

experimental group

the group in the experiment that receives a treatment or the stimuli targeting a specific behaviour

experimental hypothesis

assumes that any differences are due to a variable controlled by the experimenter

explicit memories

see declarative memories

explicit processes

correspond to ″conscious″ thought: deliberative, effortful, relatively slow, and generally under our intentional control

external (situational) attribution

the observer explains the actor′s behaviour as the result of the situation

extinction

(1) in classical conditioning, the loss or weakening of a conditioned response when a conditioned stimulus and unconditioned stimulus no longer occur together; (2) in operant conditioning, the weakening of an operant response when reinforcement is no longer available

extrinsic motivation

motivation geared toward gaining rewards or public recognition, or avoiding embarrassment

facial feedback hypothesis

our emotional expressions can influence our subjective emotional states

factor analysis

(1) a statistical technique that examines correlations between variables to find clusters of related variables, or “factors”; (2) in personality analysis,

grouping items that people respond to similarly; for instance, the terms friendly and warm

FAE

see fundamental attribution error

false consensus effect

tendency to project the self-concept onto the social world

false memory

remembering events that did not occur, or incorrectly recalling details of an event

falsifiable

the hypothesis is precise enough that it could be proven false

fast mapping

the ability to map words onto concepts or objects after only a single exposure

feature binding

the process of combining visual features into a single unit

feature detection cells

a set of cells in the visual cortex that respond selectively to simple and specific aspects of a stimulus, such as angles and edges

fetal alcohol spectrum disorders

abnormalities in mental functioning, growth, and physical development in the offspring of women who use alcohol during pregnancy

fetal stage

spans week eight of the gestational period through birth, during which time the skeletal, organ, and nervous systems become more developed and specialized

fight-or-flight response
a set of physiological changes that occur in response to psychological or physical threats

first-letter technique
uses the first letters of a set of items to spell out words that form a sentence

Five Factor Model (FFM)
a trait-based theory of personality based on the finding that personality can be described using five major dimensions

fixation
becoming preoccupied with obtaining the pleasure associated with a particular Freudian stage as a result of not being able to adequately regulate oneself and satisfy needs at that stage

fixed-interval schedule
reinforces the first response occurring after a set amount of time passes

fixed-ratio schedule
reinforcement is delivered after a specific number of responses have been completed

flashbulb memory
an extremely vivid and detailed memory about an event and the conditions surrounding how one learned about the event

fluid intelligence (Gf)
a type of intelligence used in learning new information and solving new problems not based on knowledge the person already possesses

Flynn effect
the steady population level increases in intelligence test scores over time

fMRI
see functional magnetic resonance imaging

focal lesions
small areas of brain tissue that are surgically destroyed

foot-in-the-door technique
involves making a simple request followed by a more substantial request

forebrain
the most visibly obvious region of the brain, consists of all of the neural structures that are located above the midbrain, including all of the folds and grooves on the outer surface of the brain; the multiple interconnected structures in the forebrain are critical to such complex processes as emotion, memory, thinking, and reasoning

forgetting curve
shows that most forgetting occurs right away, and that the rate of forgetting eventually slows to the point where one does not seem to forget at all

formal operational stage
(ages 11 to adulthood) the development of advanced cognitive processes such as abstract reasoning and hypothetical thinking

fovea

the central region of the retina

free association

patients are encouraged to talk or write without censoring their thoughts in any way

frequency

the number of observations that fall within a certain category or range of scores

frequency theory

the perception of pitch is related to the frequency at which the basilar membrane vibrates

frontal lobes

important in numerous higher cognitive functions, such as planning, regulating impulses and emotion, language production, and voluntary movement

frontal lobotomy

surgically severing the connections between different regions of the brain

functional fixedness

occurs when an individual identifies an object or technique that could potentially solve a problem, but can think of only its most obvious function

functional magnetic resonance imaging (fMRI)

measures brain activity by detecting the influx of oxygen-rich blood into neural areas that were just active

functional neuroimaging

a type of brain scanning that provides information about which areas of the brain are active when a person performs a particular behaviour

functionalism

the study of the purpose and function of behaviour and conscious experience

fundamental attribution error (FAE)

the tendency to over-emphasize internal (dispositional) attributions and under-emphasize external (situational) factors when explaining other people's behaviour

g

see general intelligence factor

GABA (gamma-amino butyric acid)

the primary inhibitory neurotransmitter of the nervous system, meaning that it prevents neurons from generating action potentials

GAD

see generalized anxiety disorder

GAS

see general adaptation syndrome

gate-control theory

explains our experience of pain as an interaction between nerves that transmit pain messages and those that inhibit these messages

Gc

see crystallized intelligence/em>

gender roles
the accepted attitudes and behaviours of males and females in a given society

gene knockout (KO) studies
involve removing a specific gene and comparing the characteristics of animals with and without that gene

general adaptation syndrome (GAS)
a theory of stress responses involving stages of alarm, resistance, and exhaustion

general intelligence factor (g)
a person's "mental energy," reflecting Spearman's belief that some people's brains are simply more "powerful" than others

generalization
(1) Pavlovian-process in which a response that originally occurred for a specific stimulus also occurs for different, though similar, stimuli; (2) Operant-takes place when an operant response occurs in response to a new stimulus that is similar to the stimulus present during original learning

generalization
takes place when an operant response occurs in response to a new stimulus that is similar to the stimulus present during original learning

generalized anxiety disorder (GAD)
involves frequently elevated levels of anxiety, generally from the normal challenges and stresses of everyday life

genes

the basic units of heredity; genes are responsible for guiding the process of creating the proteins that make up our physical structures and regulate development and physiological processes throughout the lifespan

genotype

the genetic makeup of an organism—the unique set of genes that comprise that individual's genetic code

germinal stage

the first phase of prenatal development, which spans from conception to two weeks

Gestalt psychology

an approach emphasizing that psychologists need to focus on the whole of perception and experience, rather than its parts

Gf

see fluid intelligence

glial cells

specialized cells of the nervous system that are involved in mounting immune responses in the brain, removing waste, and synchronizing the activity of the billions of neurons that constitute the nervous system

glucose

a sugar that serves as a primary energy source for the brain and the rest of the body

glutamate

most common excitatory neurotransmitter in the brains of vertebrates

graded membership

the observation that some concepts appear to make better category members than others

groupthink

a decision-making problem in which group members avoid arguments and strive for agreement

guided imagery

a technique used by some clinicians (and some police investigators) to help people recover details of events that they are unable to remember

gustatory system

functions in the sensation and perception of taste

habituation

a decrease in responding with repeated exposure to a stimulus or event

hallucinations

alterations in perception, such that a person hears, sees, smells, feels, or tastes something that does not actually exist, except in that person's own mind

hallucinogenic drugs

substances that produce perceptual distortions

haptics

the active, exploratory aspect of touch sensation and perception

Hawthorne effect

behaviour change that occurs as a result of being observed

hemispheric specialization

the two sides of the cortex often perform very different functions

heritability

a statistic, expressed as a number between zero and one, that represents the degree to which genetic differences between individuals contribute to individual differences in a behaviour or trait found in a population

heterozygous

if two corresponding genes at a given location on a pair of chromosomes differ

heuristics

problem-solving strategies that stem from prior experiences and provide an educated guess as to what is the most likely solution

HEXACO model of personality

a six-factor theory that generally replicates the factors of the Five Factor Model and adds one additional factor: Honesty–Humility

hippocampus

critical for learning and memory, particularly the formation of new memories

histrionic personality disorder (HPD)

characterized by excessive attention seeking and dramatic behaviour

homeostasis

the body's physiological processes that allow it to maintain consistent internal states in response to the outer environment

homozygous

if two corresponding genes at a given location on a pair of chromosomes are the same

hormones

chemicals secreted by the glands of the endocrine system

HPA axis

see hypothalamic–pituitary–adrenal axis

HPD

see >histrionic personality disorder

Human Genome Project

a massive effort to identify the components of the entire human genome

humanistic psychology

focuses on the unique aspects of each individual human, each person′s freedom to act, his or her rational thought, and the belief that humans are fundamentally different from other animals

humourism

explained both physical illnesses and disorders of personality as resulting from imbalances in key fluids in the body

Huntington's disease

a condition involving uncontrollable movements of the body, head, and face

hunter-gatherer theory

links performance on specific tasks to the different roles performed by males and females over the course of our evolutionary history

hypnosis

a procedure of inducing a heightened state of suggestibility

hypothalamic–pituitary–adrenal (HPA) axis

a neural and endocrine circuit that provides communication between the nervous system (the hypothalamus) and the endocrine system (pituitary and adrenal glands)

hypothalamus

a set of nuclei found on the bottom surface of the brain that are involved in regulating motivation and homeostasis by stimulating the release of hormones throughout the body

hypothesis

(plural: hypotheses) a testable prediction about processes that can be observed and measured

hypothesis test

a statistical method of evaluating whether differences among groups are meaningful, or could have been arrived at by chance alone

IAT

see Implicit Associations Test

iconic memory

the visual form of sensory memory

id

a collection of basic biological drives, including those directed toward sex and aggression

identifiable victim effect
people are more powerfully moved to action by the story of a single suffering person than by information about a whole group of people

identity
a clear sense of what kind of person you are, what types of people you belong with, and what roles you should play in society

idiographic approach
creating detailed descriptions of a specific person's unique personality characteristics

illusory correlations
relationships that really exist only in the mind, rather than in reality

imagination inflation
the increased confidence in a false memory of an event following repeated imagination of the event

imitation
recreating someone else's motor behaviour or expression, often to accomplish a specific goal

Implicit Associations Test (IAT)
measures how fast people can respond to images or words flashed on a computer screen

implicit memories
see nondeclarative memories

implicit processes

correspond to “unconscious” thought: intuitive, automatic, effortless, very fast, and operate largely outside of our intentional control

inattentional blindness

a failure to notice clearly visible events or objects because attention is directed elsewhere

incentives

the stimuli we seek out in order to reduce drives

incremental theory

the belief that intelligence can be shaped by experiences, practice, and effort

independent variable

the variable that the experimenter manipulates to distinguish between two or more groups

individual zone of optimal functioning (IZOF)

a range of emotional intensity in which an individual is most likely to perform at his or her best

inductive discipline

involves explaining the consequences of a child’s actions on other people, activating empathy for others’ feelings

infantile amnesia

a phenomenon in which we do not have any personal or autobiographical memories from before the third birthday

inferiority complex

the struggle many people have with feelings of inferiority, which stem from experiences of helplessness and powerlessness during childhood

informational influence
occurs when people internalize the values and beliefs of the group, coming to believe the same things and feel the same ways themselves

informed consent
a potential volunteer must be informed (know the purpose, tasks, and risks involved in the study) and give consent (agree to participate based on the information provided) without pressure

ingroup bias
positive biases toward the self get extended to include one's ingroups and people become motivated to see their ingroups as superior to their outgroups

ingroups
groups we feel positively toward and identify with

insight therapies
a general term referring to therapy that involves dialogue between client and therapist for the purposes of gaining awareness and understanding of psychological problems and conflicts

insomnia
a disorder characterized by an extreme lack of sleep

intelligence
the ability to think, understand, reason, and adapt to or overcome obstacles

intelligence quotient, or IQ

a measure of intelligence computed using a standardized test and calculated by taking a person's mental age, dividing it by his or her chronological age, and then multiplying by 100

intermittent reinforcement

see partial reinforcement

internal (dispositional) attribution

the observer explains the behaviour of the actor in terms of some innate quality of that person

intersexual selection

a situation in which members of one sex select a mating partner based on their desirable traits

intrasexual selection

a situation in which members of the same sex compete in order to win the opportunity to mate with members of the opposite sex

intrinsic motivation

the process of being internally motivated to perform behaviours and overcome challenges (e.g., a genuine desire to master a task rather than being motivated by a reward)

introjection

the internalization of the conditional regard of significant others

ion channels

small pores on the neuron's cell membrane

iris

a round muscle that adjusts the size of the pupil; it also gives the eyes their characteristic colour

IZOF
see individual zone of optimal functioning

James-Lange theory of emotion
our physiological reactions to stimuli (e.g., a racing heart) precede the emotional experience (e.g., the fear)

jet lag
the discomfort a person feels when sleep cycles are out of synchronization with light and darkness

kinesthesis
the sense of bodily motion and position

language
a form of communication that involves the use of spoken, written, or gestural symbols that are combined in a rule-based form

latent content
the actual symbolic meaning of a dream built on suppressed sexual or aggressive urges

latent inhibition
occurs when frequent experience with a stimulus before it is paired with a US makes it less likely that conditioning will occur after a single episode of illness

latent learning
learning that is not immediately expressed by a response until the organism is reinforced for doing so

law of effect
the idea that responses followed by satisfaction will occur again in the same situation whereas those that are not followed by satisfaction become less likely

learned helplessness
an acquired suppression of avoidance or escape behaviour in response to unpleasant, uncontrollable circumstances

learning
a process by which behaviour or knowledge changes as a result of experience

lens
a clear structure that focuses light onto the back of the eye

lesioning
a technique in which researchers intentionally damage an area in the brain

leucotomy
the surgical destruction of brain tissues in the pre-frontal cortex

libido
the motivation for sexual activity and pleasure

limbic system
an integrated network involved in emotion and memory

linguistic relativity

the theory that the language we use determines how we understand the world

lithium

one of the first mood stabilizers to be prescribed regularly in psychiatry, and from the 1950s to the 1980s, was the standard drug treatment for depression and bipolar disorder

localization of brain function

the idea that certain parts of the brain control specific mental abilities and personality characteristics

locked-in syndrome

a disorder in which the patient is aware and awake but, because of an inability to move his or her body, appears unconscious

longitudinal design

follows the development of the same set of individuals through time

longitudinal studies

studies that follow the same set of individuals for many years, often decades

long-term memory (LTM)

holds information for extended periods of time, if not permanently

long-term potentiation (LTP)

demonstrated that there is an enduring increase in connectivity and transmission of neural signals between nerve cells that fire together

LTM

see long-term memory

LTP

see long-term potentiation

lysergic acid diethylamide (LSD)

a laboratory-made (synthetic) drug that triggers unusual sensory experiences

magnetic resonance imaging (MRI)

a structural imaging technique in which clear images of the brain are created based on how different neural regions absorb and release energy while in a magnetic field

magnetoencephalography (MEG)

a neuroimaging technique that measures the tiny magnetic fields created by the electrical activity of nerve cells in the brain

maintenance rehearsal

prolonging exposure to information by repeating it

major depression

a disorder marked by prolonged periods of sadness, feelings of worthlessness and hopelessness, social withdrawal, and cognitive and physical sluggishness

maladaptive

a behaviour that causes distress to oneself or others, impairs day-to-day functioning, or increases the risk of injury or harm to oneself or others

manifest content

the images and storylines that we dream about

MAOIs

see monoamine oxidase inhibitors

marijuana

a drug comprising the leaves and buds of the Cannabis plant that produces a combination of hallucinogenic, stimulant, and relaxing (narcotic) effects

mastery motive

see intrinsic motivation

materialism

the belief that humans, and other living beings, are composed exclusively of physical matter

MBCT

see mindfulness-based cognitive therapy

MBSR

see mindfulness-based stress reduction

MCS

see minimally conscious state

MDMA

see Ecstasy

mean

the arithmetic average of a set of numbers

median

the 50th percentile—the point on the horizontal axis at which 50% of all observations are lower, and 50% of all observations are higher

medical model

sees psychological conditions through the same lens as Western medicine tends to see physical conditions—as sets of symptoms, causes, and outcomes, with treatments aimed at changing physiological processes in order to alleviate symptoms

meditation

any procedure that involves a shift in consciousness to a state in which an individual is highly focused, aware, and in control of mental processes

MEG

see magnetoencephalography

memory

a collection of several systems that store information in different forms for differing amounts of time

menarche

the onset of menstruation

menopause

the termination of the menstrual cycle and reproductive ability in women

mental age

the average intellectual ability score for children of a specific age

mental disorder defence

claims that the defendant was in such an extreme, abnormal state of mind when committing the crime that he or she could not discern that the actions were legally or morally wrong

mental set
a cognitive obstacle that occurs when an individual attempts to apply a routine solution to what is actually a new type of problem

method of loci
a mnemonic that connects words to be remembered to locations along a familiar path

midbrain
resides just above the hindbrain, primarily functions as a relay station between sensory and motor areas

mimicry
taking on for ourselves the behaviours, emotional displays, and facial expressions of others

mind-wandering
an unintentional redirection of attention from one's current task to an unrelated train of thought

mindfulness-based cognitive therapy (MBCT)
involves combining mindfulness meditation with standard cognitive–behavioural therapy tools

mindfulness-based stress reduction (MBSR)
a structured relaxation program based on elements of mindfulness meditation

minimally conscious state (MCS)
a disordered state of consciousness marked by the ability to show some behaviours that suggest at least partial consciousness, even if on an inconsistent basis

misinformation effect
when information occurring after an event becomes part of the memory for that event

mnemonic
a technique intended to improve memory for specific information

mode
the category with the highest frequency (that is, the category with the most observations)

monoamine oxidase inhibitors (MAOIs)
work by deactivating monoamine oxidase (MAO), an enzyme that breaks down serotonin, dopamine, and norepinephrine at the synaptic clefts of nerve cells

monocular cues
depth cues that we can perceive with only one eye

monozygotic twins
twins who come from a single ovum (egg), which makes them genetically identical (almost 100% genetic similarity)

mood-dependent memory
people remember better if their mood at retrieval matches their mood during encoding

mood stabilizers

drugs used to prevent or reduce the severity of mood swings experienced by people with bipolar disorder

morphemes

the smallest meaningful unit of a language

motivation

concerns the physiological and psychological processes underlying the initiation of behaviours that direct organisms toward specific goals

MRI

see magnetic resonance imaging

multimodal integration

the ability to combine sensation from different modalities such as vision and hearing into a single integrated perception

multiple intelligences

a model claiming that there are eight (now updated to at least nine) different forms of intelligence, each independent from the others

multiple personality disorder

see dissociative identity disorder

multiple sclerosis

a disease in which the immune system does not recognize myelin and attacks it—a process that can devastate the structural and functional integrity of the nervous system

myelin

a fatty sheath that insulates axons from one another, resulting in increased speed and efficiency of neural communication

naive realism
the assumption that the way we see things is the way that they are

narcissistic personality disorder (NPD)
characterized by an inflated sense of self-importance and an excessive need for attention and admiration, as well as intense self-doubt and fear of abandonment

narcolepsy
a disorder in which a person experiences extreme daytime sleepiness and even sleep attacks

natural selection
the process by which favourable traits become increasingly common in a population of interbreeding individuals, while traits that are unfavourable become less common

naturalistic observations
observations that unobtrusively observe and record behaviour as it occurs in the subject's natural environment

nature and nurture relationships
the inquiry into how heredity (nature) and environment (nurture) influence behaviour and mental processes

need to belong
the motivation to maintain relationships that involve pleasant feelings such as warmth, affection, appreciation, and mutual concern for each

person’s well-being

negative affectivity
the tendency to respond to problems with a pattern of anxiety, hostility, anger, guilt or nervousness

negative punishment
occurs when a behaviour decreases because it removes or diminishes a particular stimulus

negative reinforcement
involves the strengthening of a behaviour because it removes or diminishes a stimulus

negative symptoms
the absence of adaptive behaviour, such as absent or flat emotional reactions, lack of interacting with others in a social setting, and lack of motivation

negatively skewed distribution
a distribution in which the curve has an extended tail to the left of the cluster

neglect (or visual neglect)
a situation in which the patient does not attend to anything that appears in the left half of his or her visual field

neurodevelopmental hypothesis
the adult manifestation of what we call “schizophrenia” is the outgrowth of disrupted neurological development early in the person’s life

neurogenesis

the formation of new neurons

neurons
one of the major types of cells found in the nervous system, which are responsible for sending and receiving messages throughout the body

neuroplasticity
the capacity of the brain to change and rewire itself based on individual experience

neurotransmitters
the chemicals that function as messengers allowing neurons to communicate with each other

night terrors
intense bouts of panic and arousal that awaken the individual, typically in a heightened emotional state

nightmares
particularly vivid and disturbing dreams that occur during REM sleep

nociception
the activity of nerve pathways that respond to uncomfortable stimulation

nomothetic approach
examines personality in large groups of people, with the aim of making generalizations about personality structure

non-declarative memories
include actions or behaviours that you can remember and perform without awareness

nootropic substances

substances that are believed to beneficially affect intelligence

noradrenaline

see norepinephrine

norepinephrine

(also known as noradrenaline) a monoamine synthesized from dopamine molecules that is involved in regulating stress responses, including increasing arousal, attention, and heart rate

normal distribution

a symmetrical distribution with values clustered around a central, mean value

normative influence

the result of a social pressure to adopt a group's perspective in order to be accepted, rather than rejected, by a group

null hypothesis

assumes that any differences between groups (or conditions) are due to chance

NPD

see narcissistic personality disorder

obesity

a disorder of positive energy balance, in which energy intake exceeds energy expenditure

object permanence

the ability to understand that objects exist even when they cannot be directly perceived

object relations therapy
a variation of psychodynamic therapy that focuses on how early childhood experiences and emotional attachments influence later psychological functioning

objective measurements
the measure of an entity or behaviour that, within an allowed margin of error, is consistent across instruments and observers

observational learning
involves changes in behaviour and knowledge that result from watching others

obsessive–compulsive disorder (OCD)
plagued by unwanted, inappropriate, and persistent thoughts (obsessions), and tending to engage in repetitive, almost ritualistic, behaviours (compulsions)

occipital lobes
located at the rear of the brain and are where visual information is processed

OCD
see obsessive–compulsive disorder

olfactory bulb
a structure on the bottom surface of the frontal lobes that serves as the brain's central region for processing smells

olfactory epithelium

a thin layer of cells that are lined by sensory receptors called cilia

olfactory system

involved in smell—the detection of airborne particles with specialized receptors located in the nose

operant conditioning

a type of learning in which behaviour is influenced by consequences

operational definitions

statements that describe the procedures (or operations) and specific measures that are used to record observations

opiates

(also called narcotics) drugs such as heroin and morphine that reduce pain and induce extremely intense feelings of euphoria

opponent-process theory

a theory of colour perception stating that we perceive colour in terms of opposing pairs: red to green, yellow to blue, and white to black

optic chiasm

the point at which the optic nerves cross at the midline of the brain

optic nerve

a dense bundle of fibres that connect to the brain

optimism

the tendency to have a favourable, constructive view on situations and to expect positive outcomes

ostracism

being ignored or excluded from social contact

outgroups

those "other" groups that we don't identify with

oxytocin

a stress-sensitive hormone that is typically associated with maternal bonding and social relationships

panic attacks

brief moments of extreme anxiety that include a rush of physical activity paired with frightening thoughts

panic disorder

an anxiety disorder marked by occasional episodes of sudden, very intense fear

paranoid personality disorder (PDP)

individuals are consistently preoccupied by the belief that other people are attempting to harm or deceive them; they often react with anger to these imagined social or physical threats

paranoid schizophrenia

symptoms include delusional beliefs that one is being followed, watched, or persecuted, and may also include delusions of grandeur or the belief that one has some secret, insight, power, or some other characteristic that makes one particularly special

parasitic processing

mutually reinforcing feedback loops linking different cognitive and neural processes together

parasympathetic nervous system
helps maintain homeostatic balance in the presence of change; following sympathetic arousal, it works to return the body to a baseline, nonemergency state

Parkinson's disease
a neurological disorder involving tremors and difficulties making movements

parietal lobes
involved in our experiences of touch as well our bodily awareness

partial reinforcement
only a certain number of responses are rewarded, or a certain amount of time must pass before reinforcement is available

partial reinforcement effect
a phenomenon in which organisms that have been conditioned under partial reinforcement resist extinction longer than those conditioned under continuous reinforcement

passionate love
associated with a physical and emotional longing for the other person

Pavlovian conditioning
see classical conditioning

peer review

a process in which papers submitted for publication in scholarly journals are read and critiqued by experts in the specific field of study

perception
involves attending to, organizing, and interpreting stimuli that we sense

perceptual constancy
the ability to perceive objects as having constant shape, size, and colour despite changes in perspective

performance motive
see extrinsic motivation

peripheral nervous system (PNS)
a division of the nervous system that transmits signals between the brain and the rest of the body and is divided into two subcomponents, the somatic system and the autonomic system

peripheral route to persuasion
depends upon features that are not directly related to the message itself, such as the attractiveness of the person delivering the information

persistent vegetative state
state of minimal to no consciousness in which the patient's eyes may be open, and the individual will develop sleep–wake cycles without clear signs of consciousness

person perception
the processes by which individuals categorize and form judgments about other people

personal unconscious

a vast repository of experiences and patterns that are absorbed during the entire experiential unfolding of the person's life

personality
a characteristic pattern of thinking, feeling, and behaving that is unique to each individual, and remains relatively consistent over time and situations

personality disorders
particularly unusual patterns of behaviour (relative to one's cultural context), that are maladaptive, distressing to oneself or others, and resistant to change

personality psychology
the study of how different personality characteristics can influence how we think and act

personality trait
a specific psychological characteristic that makes up part of a person's personality

person-centred perspective
founded on the assumption that people are basically good, and given the right environment their personality will develop fully and normally

person-centred therapy
see client-centred therapy

pessimism
the tendency to have a negative perception of life and expect negative outcomes

pessimistic explanatory style

the tendency to interpret and explain negative events as internally based (i.e., as being due to that person rather than to an external situation) and as a constant, stable quality

PET

see positron emission tomography

phantom limb sensations

frequently experienced by amputees, who report pain and other sensations coming from the absent limb

phenomenological approach

the therapist addresses the clients' feelings and thoughts as they unfold in the present moment, rather than looking for unconscious motives or dwelling in the past

phenotype

the physical traits and behavioural characteristics that show genetic variation, such as eye colour, the shape and size of facial features, intelligence, and even personality

phobia

a severe, irrational fear of a very specific object or situation

phonemes

the most basic of unit of speech sounds

phonological loop

a storage component of working memory that relies on rehearsal and that stores information as sounds, or an auditory code

phrenology

the theory that personality characteristics could be assessed by carefully measuring the outer skull

physical dependence

the need to take a drug to ward off unpleasant physical withdrawal symptoms

pitch

the perceptual experience of sound wave frequencies

pituitary gland

the master gland of the endocrine system that produces hormones and sends commands about hormone production to the other glands of the endocrine system

place theory of hearing

how we perceive pitch is based on the location (place) along the basilar membrane that sound stimulates

placebo effect

a measurable and experienced improvement in health or behaviour that cannot be attributable to a medication or treatment

polysomnography

a set of objective measurements used to examine physiological variables during sleep

population

the group that researchers want to generalize about

positive psychology

uses scientific methods to study human strengths and potential

positive punishment
a process in which a behaviour decreases in frequency because it was followed by a particular, usually unpleasant, stimulus

positive reinforcement
the strengthening of behaviour after potential reinforcers such as praise, money, or nourishment follow that behaviour

positive symptoms
the presence of maladaptive behaviours, such as confused and paranoid thinking, and inappropriate emotional reactions

positively skewed distribution
a distribution in which the long tail is on the right of the cluster

positron emission tomography (or PET)
a type of scan in which a low level of a radioactive isotope is injected into the blood, and its movement to regions of the brain engaged in a particular task is measured

postconventional morality
considers rules and laws as relative

postsynaptic cell (or postsynaptic neuron)
is the neuron that receives neurotransmitters from the presynaptic cell

post-traumatic growth
the capacity to grow and experience long-term positive effects in response to negative events

post-traumatic stress disorder (PTSD)

is a common psychological illness involving recurring thoughts, images, and nightmares associated with a traumatic event; it induces symptoms of tension and anxiety and can seriously interfere with many aspects of a person's life

pragmatics

the study of nonlinguistic elements of language use

preconventional morality

characterized by self-interest in seeking reward or avoiding punishment

prejudice

affective, emotionally laden responses to members of outgroups, including holding negative attitudes and making critical judgments of other groups

preoperational stage

(ages two to seven) the stage of development devoted to language development, using symbols, pretend play, and mastering the concept of conservation

preparedness

the biological predisposition to rapidly learn a response to a particular class of stimuli

preserve and protect hypothesis

suggests that two adaptive functions of sleep are preserving energy and protecting the organism from harm

preterm infant

an infant born earlier than 36 weeks of gestation

presynaptic cell (or presynaptic neuron) presynaptic cell
is the neuron that releases its neurotransmitters into the synapse

primary auditory cortex
a major perceptual centre of the brain involved in perceiving what we hear

primary reinforcers
reinforcing stimuli that satisfy basic motivational needs—needs that affect an individual's ability to survive (and, if possible, reproduce)

primary sex traits
changes in the body that are part of reproduction

priming
the activation of individual concepts in long-term memory

principle of parsimony
the simplest of all competing explanations (the most "parsimonious") of a phenomenon should be the one we accept

proactive interference
a process in which the first information learned (e.g., in a list of words) occupies memory, leaving fewer resources to remember the newer information

problem solving
accomplishing a goal when the solution or the path to the solution is not clear

problem-solving theory

the theory that thoughts and concerns are continuous from waking to sleeping, and that dreams may function to facilitate finding solutions to problems encountered while awake

procedural memories
patterns of muscle movements (motor memory)

prodromal phase
phase of schizophrenia during which people may become easily confused and have difficulty organizing their thoughts, they may lose interest and begin to withdraw from friends and family, and they may lose their normal motivations, withdraw from life, and spend increasing amounts of time alone, often deeply engrossed in their own thoughts

projective tests
personality tests in which ambiguous images are presented to an individual to elicit responses that reflect unconscious desires or conflicts

prosopagnosia
an inability to recognize faces or face blindness

prototype
a mental representation of an average category member

pseudoscience
an idea that is presented as science but does not actually utilize basic principles of scientific thinking or procedure

psychedelics
substances that produce perceptual distortions

psychiatrists

medical doctors who specialize in mental health and who are allowed to diagnose and treat mental disorders primarily through prescribing medications

psychoactive drugs
substances that affect thinking, behaviour, perception, and emotion

psychoanalysis
a psychological approach that attempts to explain how behaviour and personality are influenced by unconscious processes

psychodynamic therapies
forms of insight therapy that emphasize the need to discover and resolve unconscious conflicts

psychological dependence
occurs when emotional need for a drug develops without any underlying physical dependence

psychology
the scientific study of behaviour, thought, and experience, and how they can be affected by physical, mental, social, and environmental factors

psychoneuroimmunology
the study of the relationship between immune system and nervous system functioning

psychopharmacotherapy
the use of drugs to attempt to manage or reduce clients' symptoms

psychophysics

the study of the relationship between the physical world and the mental representation of that world

psychotropic drugs
medications designed to alter psychological functioning

PTSD
see post-traumatic stress disorder

punisher
a stimulus that is contingent upon a response, and that results in a decrease in behaviour

punishment
a process that decreases the future probability of a response

pupil
regulates the amount of light that enters the eye by changing its size; it dilates (expands) to allow more light to enter and constricts (shrinks) to allow less light into the eye

qualitative research
examining an issue or behaviour without performing numerical measurements of the variables

quantitative research
examining an issue or behaviour by using numerical measurements and/or statistics

quasi-experimental research

a research technique in which the two or more groups that are compared are selected based on predetermined characteristics, rather than random assignment

random assignment
a technique for dividing samples into two or more groups in which participants are equally likely to be placed in any condition of the experiment

random sample
a sampling technique in which every individual of a population has an equal chance of being included

Raven's Progressive Matrices
an intelligence test that is based on pictures, not words, thus making it relatively unaffected by language or cultural background

recall
retrieving information when asked but without that information being present during the retrieval process

reciprocal determinism
behaviour, internal (personal) factors, and external (situational) factors interact to determine one another, and our personalities are based on interactions among these three aspects

recognition
identifying a stimulus or piece of information when it is presented to you

reconsolidation

in which the hippocampus functions to update, strengthen, or modify existing long-term memories

recovered memory

a memory of a traumatic event that is suddenly recovered after blocking the memory of that event for a long period of time

recovered memory controversy

a heated debate among psychologists about the validity of recovered memories

reflexes

involuntary muscular reactions to specific types of stimulation

refractory period

(1) brief period in which a neuron cannot fire; (2) a time period during which erection and orgasm are not physically possible

rehearsal

repeating information until you do not need to remember it anymore

reinforcement

a process in which an event or reward that follows a response increases the likelihood of that response occurring again

reinforcer

a stimulus that is contingent upon a response, and that increases the probability of that response occurring again

reliability

consistent and stable answers across multiple observations and points in time

REM behaviour disorder

a condition that does not show the typical restriction of movement during REM sleep; in fact, they appear to be acting out the content of their dreams

REM sleep

a stage of sleep characterized by quickening brain waves, inhibited body movement, and rapid eye movements (REM)

repetitive transcranial magnetic stimulation (rTMS)

a therapeutic technique in which a focal area of the brain is exposed to a powerful magnetic field across several different treatment sessions

replication

the process of repeating a study and finding a similar outcome each time

representativeness heuristic

making judgments of likelihood based on how well an example represents a specific category

research design

a set of methods that allows a hypothesis to be tested

research ethics board (REB)

a committee of researchers and officials at an institution charged with the protection of research participants

residential treatment centres

housing facilities in which residents receive psychological therapy and life skills training with the explicit goal of helping residents become re-integrated into society

residual phase

phase of schizophrenia during which people's predominant symptoms have disappeared or lessened considerably, and they may simply be withdrawn, have trouble concentrating, and generally lack motivation

residual schizophrenia

This category reflects individuals who show some symptoms of schizophrenia but are either in transition to a full-blown episode or in remission

resilience

the ability to effectively recover from illness or adversity

resistance

when the patient engages in strategies that keep unconscious thoughts or motivations that they wish to avoid from fully manifesting in conscious awareness

response styles

characteristic ways of responding to questions

resting potential

relatively stable state during which the cell is not transmitting messages

restore and repair hypothesis

the idea that the body needs to restore energy levels and repair any wear and tear experienced during the day's activities

reticular formation

extends from the medulla upwards to the midbrain and is involved with attention and alertness

retina
lines the inner surface of the eye and consists of specialized receptors that absorb light and send signals related to the properties of light to the brain

retinal disparity
(also called binocular disparity) the difference in relative position of an object as seen by both eyes, which provides information to the brain about depth

retrieval
brings information from LTM back into STM

retroactive interference
the most recently learned information overshadows some older memories that have not yet made it into long-term memory

retrograde amnesia
a condition in which memory for the events preceding trauma or injury is lost

reuptake
a process whereby neurotransmitter molecules that have been released into the synapse are reabsorbed into the axon terminals of the presynaptic neuron

right-wing authoritarianism (RWA)
a problematic set of personality characteristics that also predisposes people to certain types of violent or anti-social tendencies: (1) obeying orders and deferring to the established authorities in a society; (2) supporting aggression against those who dissent or differ from the established social order; and (3) believing strongly in maintaining the existing social order

rods

photoreceptors that occupy peripheral regions of the retina; they are highly sensitive under low light levels

Rorschach inkblot test

a test in which people are asked to describe what they see on an inkblot, and psychologists interpret this description using a standardized scoring and interpretation method

rTMS

see repetitive transcranial magnetic stimulation

rule-based categorization

categorizing objects or events according to a certain set of rules or by a specific set of features

RWA

see right-wing Authoritarianism

salvia divinorum

an herb that grows in Central and South America. When smoked or chewed, salvia induces highly intense but short-lived hallucinations

sample

a select group of population members

satiation

the point in a meal when we are no longer motivated to eat

savant

an individual with low mental capacity in most domains but extraordinary abilities in other specific areas such as music, mathematics, or art

scaffolding

a highly attentive approach to teaching in which the teacher matches guidance to the learner's needs

schedules of reinforcement

rules that determine when reinforcement is available

schemas

organized clusters of memories that constitute one's knowledge about events, objects, and ideas

schizoid personality disorder

an individual is socially detached; he or she does not desire close relationships, including being part of a family, and takes little pleasure in most activities

schizophrenia

a brain disease that causes the person to experience significant breaks from reality, a lack of integration of thoughts and emotions, and problems with attention and memory

schizotypal personality disorder

a discomfort with close relationships as well as unusual or eccentric thoughts and behaviours

scientific literacy

the ability to understand, analyze, and apply scientific information

scientific method

a way of learning about the world through collecting observations, developing theories to explain them, and using the theories to make predictions

sclera
is the white, outer surface of the eye

secondary reinforcers
stimuli that acquire their reinforcing effects only after we learn that they have value

secondary sex traits
changes in the body that are not part of reproduction

sedative drugs
sometimes referred to as "downers," depress activity of the central nervous system

selective attention
involves focusing on one particular event or task

selective serotonin reuptake inhibitors (SSRIs)
a class of antidepressant drugs that block the reuptake of the neurotransmitter serotonin

self-actualization
the point at which a person reaches his or her full potential as a creative, deep-thinking, and accepting human being

self-awareness
the ability to recognize one's individuality

self-determination theory

an individual's ability to achieve their goals and attain psychological well-being is influenced by the degree to which he or she is in control of the behaviours necessary to achieve those goals

self-efficacy

an individual's confidence that he or she can plan and execute a course of action in order to solve a problem

self-fulfilling prophecies

a first impression (or an expectation) affects one's behaviour, and then that affects other people's behaviour, leading one to "confirm" the initial impression or expectation

self-reference effect

occurs when you think about information in terms of how it relates to you or how it is useful to you; this type of encoding will lead to you remembering that information better than you otherwise would have

self-reporting

a method in which responses are provided directly by the people who are being studied, typically through face-to-face interviews, phone surveys, paper and pencil tests, and web-based questionnaires

self-serving biases

biased ways of processing self-relevant information to enhance our positive self-evaluation

semantic memories

declarative memories that include facts about the world

semantic network

an interconnected set of nodes (or concepts) and the links that join them to form a category

semantics

the study of how people come to understand meaning from words

semicircular canals

three fluid-filled canals found in the inner ear that respond when the head moves in different directions (up-down, left-right, forward-backward)

sensation

the process of detecting external events with sense organs and turning those stimuli into neural signals

sensitive period

a window of time during which exposure to a specific type of environmental stimulation is needed for normal development of a specific ability

sensorimotor stage

from birth to two years, a time during which infants' thinking about and exploration of the world are based on immediate sensory (e.g., seeing, feeling) and motor (e.g., grabbing, mouthing) experiences

sensory adaptation

the reduction of activity in sensory receptors with repeated exposure to a stimulus

sensory memory

a memory store that accurately holds perceptual information for a very brief amount of time

serial position effect

in general, most people will recall the first few items from a list and the last few items, but only an item or two from the middle

serotonin

a monoamine involved in regulating mood, sleep, aggression, and appetite

set point

a hypothesized mechanism that serves to maintain body weight around a physiologically programmed level

sex guilt

negative emotional feelings for having violated culturally accepted standards of appropriate sexual behaviour

sexual orientation

the consistent preference for sexual relations with members of the opposite sex (heterosexuality), same sex (homosexuality), or either sex (bisexuality)

sexual response cycle

the phases of physiological change during sexual activity, which comprises four primary stages: excitement, plateau, orgasm, and resolution

sexual scripts

the set of rules and assumptions about the sexual behaviours of males and females

shallow processing

encoding more superficial properties of a stimulus, such as the sound or spelling of a word

sham group (or sham lesion group)
a set of animals that go through all of the surgical procedures aside from the lesion itself in order to control for the effects of stress, anesthesia, and the annoyance of stitches. An example of the lesion method is found in studies of spatial learning

shaping
reinforcing successive approximations of a specific operant response

short-term memory (STM)
a memory store with limited capacity and duration (approximately 30 seconds)

signal detection theory
whether a stimulus is perceived depends on both sensory experience and judgments made by the subject

single-blind study
a study in which participants do not know the true purpose of the study, or else do not know which type of treatment they are receiving (for example, a placebo or a drug)

situational attributions
see external attribution

sleep apnea
a disorder characterized by the temporary inability to breathe during sleep

sleep deprivation

occurs when an individual cannot or does not sleep

sleep displacement

occurs when an individual is prevented from sleeping at the normal time although she or he may be able to sleep earlier or later in the day than usual

social anxiety disorder

a very strong fear of being judged by others or being embarrassed or humiliated in public

social contagion

the often subtle, unintentional spreading of a behaviour as a result of social interactions

social desirability (or socially desirable responding)

research participants respond in ways that increase the chances that they will be viewed favourably

social facilitation

occurs when one's performance is affected by the presence of others

social loafing

occurs when an individual puts less effort into working on a task with others

social norms

the (usually unwritten) guidelines for how to behave in social contexts

social psychology

the study of the influence of other people on our behaviour

social resilience

the ability to keep positive relationships and to endure and recover from social isolation and life stressors

social roles

are guidelines that apply to specific positions within the group

social-cognitive theory

explains hypnosis by emphasizing the degree to which beliefs and expectations contribute to increased suggestibility

socioemotional selectivity theory

describes how older people have learned to select for themselves more positive and nourishing experiences

soma

see cell body

somatic nervous system

consists of nerves that control skeletal muscles, which are responsible for voluntary and reflexive movement; it also consists of nerves that receive sensory input from the body

somnambulism

or sleepwalking, a disorder that involves wandering and performing other activities while asleep

sound localization

the process of identifying where sound comes from

source memory

the memory for how or where information was initially acquired

specific phobia

an intense fear of a specific object, activity, or organism

spermarche

during puberty, a male's first ejaculation of sperm

spontaneous recovery

the reoccurrence of a previously extinguished conditioned response, typically after some time has passed since extinction

SSRIs

see selective serotonin reuptake inhibitors

standard deviation

a measure of variability around the mean

Stanford-Binet test

a test intended to measure innate levels of intelligence

state

a temporary physical or psychological engagement that influences behaviour

state-dependent memory

memory retrieval is more effective when your internal state matches the state you were in during encoding

statistical significance

the means of the groups are farther apart than you would expect them to be by random chance alone

stem cells

a unique type of cell that does not have a predestined function

stereotype
a cognitive structure, a set of beliefs about the characteristics that are held by members of a specific social group; these beliefs function as schemas, serving to guide how we process information about our social world

stereotype threat
occurs when negative stereotypes about a group cause group members to underperform on ability tests

stimulants
a category of drugs that speed up the nervous system, typically enhancing wakefulness and alertness

STM
see short-term memory

storage
the time and manner in which information is retained between encoding and retrieval

stores
retain information in memory without using it for any specific purpose

strange situation
a way of measuring infant attachment by observing how infants behave when exposed to different experiences that involve anxiety and comfort

stress
a psychological and physiological reaction that occurs when perceived demands exceed existing resources to meet those demands

structural neuroimaging

a type of brain scanning that produces images of the different structures of the brain

structuralism

an attempt to analyze conscious experience by breaking it down into basic elements, and to understand how these elements work together

subliminal perception

perception below the threshold of conscious awareness

superego

comprised of our values and moral standards

sympathetic nervous system

responsible for the fight-or-flight response of an increased heart rate, dilated pupils, and decreased salivary flow—responses that prepare the body for action

synapses

an area consisting of a neuron's axon terminals and a different neuron's dendrites; these structures are separated by a microscopic space into which neurotransmitters can be released

synaptic cleft

the minute space between the axon terminal (terminal button) and the dendrite

synaptic pruning

the loss of weak nerve cell connections

synaptogenesis

the forming of new synaptic connections

syntax
the rules for combining words and morphemes into meaningful phrases and sentences

systematic desensitization
gradual exposure to a feared stimulus or situation is coupled with relaxation training

systems approach
an orientation that encourages therapists to see an individual's symptoms as being influenced by many different interacting systems

tardive dyskinesia
a movement disorder involving involuntary movements and facial tics

TAT
see Thematic Apperception Test

temporal lobes
located at the sides of the brain near the ears and are involved in hearing, language, and some higher-level aspects of vision such as object and face recognition

teratogens
substances, such as drugs or environmental toxins, that impair the process of fetal development

terror management theory (TMT)

a psychological perspective asserting that the human fear of mortality motivates behaviour, particularly those that preserve self-esteem and our sense of belonging

testing effect
the finding that taking practice tests can improve exam performance, even without additional studying

testosterone
a hormone that is involved in the development of sex characteristics and the motivation of sexual behaviour

thalamus
a set of nuclei involved in relaying sensory information to different regions of the brain

Thematic Apperception Test (TAT)
a test in which respondents are asked to tell stories about ambiguous pictures involving various interpersonal situations

theory
an explanation for a broad range of observations that also generates new hypotheses and integrates numerous findings into a coherent whole

theory of mind
the ability to understand that other people have thoughts, beliefs, and perspectives that may be different from one's own

therapeutic alliance
the relationship between the therapist and the patient that emerges in therapy

thin slices of behaviour

very small samples of a person's behaviour

third variable problem

the possibility that a third, unmeasured variable is actually responsible for a well-established correlation between two variables

tip-of-the-tongue (TOT) phenomenon

when you are able to retrieve similar sounding words or words that start with the same letter but can't quite retrieve the word you actually want

TMT

see terror management theory

tolerance

when repeated use of a drug results in a need for a higher dose to get the intended effect

top-down processing

when our perceptions are influenced by our expectations or by our prior knowledge

Tourette's syndrome

a condition marked by erratic and repetitive facial and muscle movements (called tics), heavy eye blinking, and frequent noise making such as grunting, snorting, or sniffing

transcranial magnetic stimulation (TMS)

a procedure in which an electromagnetic pulse is delivered to a targeted region of the brain

transduction

takes place when specialized receptors transform the physical energy of the outside world into neural impulses

transference
a psychodynamic process whereby patients direct certain patterns or emotional experiences toward the analyst, rather than the original person involved in the experiences (e.g., their parents)

transgender
individuals who experience a mismatch between the gender that they identify with and their biological sex

transsexual
the subset of transgender individuals who wish to permanently transition from their birth sex to the gender with which they identify

triarchic theory of intelligence
a theory that divides intelligence into three distinct types: analytical, practical, and creative

trichromatic theory (Young-Helmholtz theory)
maintains that colour vision is determined by three different cone types that are sensitive to short, medium, and long wavelengths of light

tricyclic antidepressants
appear to work by blocking the reuptake of serotonin and norepinephrine

trophic factors
chemicals that stimulate the growth of new dendrites and axons

two-factor theory

patterns of physical arousal and the cognitive labels we attach to them form the basis of our emotional experiences

Type A personality

people who tend to be impatient and worry about time, and are easily angered, competitive, and highly motivated

Type B personality

people who are more laid back and characterized by a patient, easygoing, and relaxed disposition

unconditioned response (UR)

a reflexive, unlearned reaction to an unconditioned stimulus

unconditioned stimulus (US)

a stimulus that elicits a reflexive response without learning

unconscious mind

a vast and powerful but inaccessible part of your consciousness, operating without your conscious endorsement or will to influence and guide your behaviours

undifferentiated schizophrenia

This category includes individuals who show a combination of symptoms from more than one type of schizophrenia

unit bias

the tendency to assume that the unit of sale or portioning is an appropriate amount to consume

UR

see unconditioned response

US

see unconditioned stimulus

validity

the degree to which an instrument or procedure actually measures what it claims to measure

variability

the degree to which scores are dispersed in a distribution

variable

the object, concept, or event being measured

variable-interval schedule

the first response is reinforced following a variable amount of time

variable-ratio schedule

the number of responses required to receive reinforcement varies according to an average

ventral stream

a neural circuit for vision that extends from the visual cortex to the lower part of the temporal lobe

vestibular sacs

structures that influence your ability to detect when your head is no longer in an upright position

vestibular system

a sensory system in the ear that provides information about spatial orientation of the head as well as head motion

virtual reality exposure (VRE)
a treatment that uses graphical displays to create an experience in which the client seems to be immersed in an actual environment

visuospatial sketchpad
a storage component of working memory that maintains visual images and spatial layouts in a visuospatial code

weapon focus
the tendency to focus on a weapon at the expense of peripheral information including the identity of the person holding the weapon

Weber's law
states that the just noticeable difference between two stimuli changes as a proportion of those stimuli

Wechsler Adult Intelligence Scale (WAIS)
the most common intelligence test in use today for adolescents and adults

Wernicke's area
the area of the brain most associated with finding the meaning of words

Whorfian hypothesis
see linguistic relativity

within-subjects design
an experimental design in which the same participants respond to all types of stimuli or experience all experimental conditions

word-length effect

people remember more one-syllable words than four- or five-syllable words in a short-term-memory task

working memory

a model of short-term remembering that includes a combination of memory components that can temporarily store small amounts of information for a short period of time

Young-Helmholtz theory

see trichromatic theory

zeitgeist

refers to a general set of beliefs of a particular culture at a specific time in history

zone of proximal development

the concept that development is ideal when children attempt skills and activities that are just beyond what they can do alone, but they have guidance from adults who are attentive to their progress

zygote

the initial cell formed when the nuclei of egg and sperm fuse

Pearson Canada Inc., 26 Prince Andrew Place, North York, Ontario M3C 2H4.

ISBN 978-0-13-542412-4

Library and Archives Canada Cataloguing in Publication

Title: An introduction to psychological science / Mark Krause (Southern Oregon University), Daniel Corts (Augustana College), Stephen Smith (University of Winnipeg) Names: Krause, Mark A. (Mark Andrew), author. | Corts, Daniel Paul, author. | Smith, Stephen, author.
Description: Third Canadian edition. | Includes bibliographical references and index. Identifiers: Canadiana (print) 20190169974 | Canadiana (ebook) 20190169982 | ISBN 9780135424179 (softcover; Instructor's edition) | ISBN 9780135424124 (ebook) | ISBN 9780135423950 (looseleaf edition)
Subjects: LCSH: Psychology—Textbooks. | LCGFT: Textbooks.
Classification: LCC BF121 .K73 2019 | DDC 150—dc23

The left side of the screen shows the text “Audio: Listen and learn as you go with full audio of your text (available for most courses).” The image below shows a smartphone displaying course content, with a button labeled “Listen to the Audio,” and audio controls at the bottom of the screen indicating that the audio is playing. The right side of the screen shows the text “Notifications: Set your own notifications so you never miss a deadline again.” The image below shows a smartphone displaying a Revel notification for an assignment that is due in one day.

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description

Long description